Vol. XXI. — 22 | No. 1.

(1909–1917)

THE JOURNAL

OF THE

Cincinnati Society of Natural History

... Published September, 1909 ...

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Article I.—SILURIAN FOSSILS FROM THE KOKOMO, WEST UNION, AND ALGER HORIZONS OF INDIANA, OHIO AND KENTUCKY. By AUG. F. FOERSTE.

ARTICLE I.—SILURIAN FOSSILS FROM THE KOKOMO, WEST UNION, AND ALGER HORIZONS OF INDIANA, OHIO AND KENTUCKY.

By Aug. F. Foerste.

In Ohio, the Silurian section was divided by Professor Orton into the following lithological units, named in descending order:

Hillsboro sandstone.
Cedarville limestone.
Springfield limestone.
West Union limestone.
Niagara shale.
Dayton limestone.
Clinton limestone.

In east-central Kentucky, the following horizons can be recognized, also named in descending order:

Crab Orchard formation	Alger member	Estill clay
		Waco limestone
		Lulbegrud clay
	Indian Fields member	Oldham limestone
		Plum creek clay
Clinton formation		Brassfield limestone.

In this classification, the Brassfield limestone is the southern continuation of the strata which were identified in Ohio, by Professor Orton, as Clinton. The Oldham limestone apparently is equivalent to the Dayton limestone. The Plum creek clay is a local deposit and can not be traced with confidence beyond east-central Kentucky. This is true also of the Waco limestone, so that the northward extension of the Alger member of the Crab Orchard formation consists only of clay and clay shale uninterrupted by limestones, and corre-

sponds to the so-called Niagara shales of Adams and Highland counties in Ohio.

In former years, the name Beavertown marl was used for a very fine grained limestone, 9 inches thick, weathering to a rather soft rock, in which a small depauperate fauna, consisting chiefly of a small species of *Orthoceras* and several gasteropods, was found. This rock occurred at Dayton, Ohio, in an area about 4 or 5 miles in diameter, immediately above the soft, richly fossiliferous clays with which the Brassfield bed terminates in Montgomery, and adjacent counties, in Ohio. The term marl, for the 9-inch layer, at the base of the Dayton limestone, is not appropriate, and at present this layer is included in the Dayton limestone. The richly fossiliferous clay at the top of the so-called Clinton limestone of Ohio carries the same fauna as the underlying limestone, merely more frequently as free specimens, and, therefore, more interesting to the collector. This clay never has received a separate designation, and in my opinion does not need any. It is not the stratum to which the name Beavertown marl was applied originally, but immediately underlies the latter.

In Lewis county, Kentucky, the Alger member of the Crab Orchard formation is overlaid by a variable thickness of Silurian limestone. This limestone was investigated by Mr. W. S. Morse and myself at numerous localities, and a fair fauna was collected, described on the following pages. This limestone may be traced along the bold bluffs of the Ohio river from the neighborhood of Vanceburg, in Kentucky, to the mouth of Brush Creek, in Adams county, Ohio. Stratigraphically it occupies the same position as the West Union bed, in Adams county. No strata equivalent to the Springfield, Cedarville, or Hillsboro divisions of the Ohio Silurian have been identified so far in Kentucky.

In Lewis and Fleming counties, in Kentucky, the upper part of the Crab Orchard formation contains more or less thin-bedded indurated argillaceous shale. This phase continues northward into Ohio, and is well exposed west of

Peebles, in the northern part of Adams county. It is the upper part of the Alger member. In Lewis county, Kentucky, the following fauna has been collected from this upper part of the Crab Orchard formation:

Calymene clintoni, Hall.
Beyrichia lata-triplicata, Foerste.
Chonetes vetustus, Foerste.
Stropheodonta mundula, sp. nov.
Camarotoechia congruens, sp. nov.

This fauna is of interest since *Calymene clintoni* and *Beyrichia lata* may be regarded as representatives of the eastern Clinton, as exposed in Oneida county, New York.

In the lower part of the West Union limestone overlying the Crab Orchard formation, in the vicinity of Martins, in Lewis county, Kentucky, the following fauna was collected in a single, small, strongly weathered sandy block:

Dalmanites limulurus-brevicaudatus, var. nov.
Homolanotus delphinocephalus, Green.
Calymene niagarensis, Hall.
Illaenus depressus, Foerste.
Diaphorostoma cliftonensis, Foerste.
Stropheodonta planus, sp. nov.
Spirifer radiatus, Sowerby.
Camarotoechia pisa (?), Hall and Whitfield.
Camarotoechia acinus-subrhomboidea, var. nov.
Camarotoechia congruens, sp. nov.
Favosites sp.

It is of interest to note that in Oneida county, New York, *Dalmanites limulurus* and *Homolanotus delphinocephalus* occur in the top of the series to which the name Clinton was originally applied, apparently above the *Calymene clintoni* horizon.

The recent investigations of Wm. F. Prouty, in the Meso-Silurian deposits of Maryland, have resulted in finding a fauna containing *Dalmanites limulurus* and *Homolanotus delphinocephalus* immediately above another fauna containing *Calymene clintoni*. This *Calymene clintoni* fauna occurs in the upper fossiliferous division of a series of clays or argillaceous

shales, interbedded with thin sandstone bands, which are more frequent toward the bottom. The thickness of the total section, identified by Prouty as Clinton, is about 550 feet, and of this the upper fossiliferous section, containing Calymene clintoni, occupies a thickness of about 100 feet.

Overlying the Clinton section of Prouty, is a series of strata about 300 feet thick, in which limestones are frequent, although interbedded with more or less argillaceous shale. This limestone section has been identified by Prouty as Rochester. In the lower part of this series, sometimes 30 feet thick, although usually less, the fauna containing *Dalmanites limulurus* and *Homolanotus* is found.

Between the Clinton argillaceous shales and the Rochester section with its numerous limestone layers, there is a sandstone, thicker eastward, thinner westward, in the top portion of which a ferruginous layer is present.

It is significant in this connection to note that the fossiliferous block containing the fauna listed above from Martins, in Lewis county, Kentucky, was distinctly sandy, and that a considerable part of the West Union section at this locality is rather coarse-grained and cross-bedded. It seems possible therefore, to correllate the Crab Orchard clay section of Lewis county, Kentucky, consisting of that part, 100 feet thick, which overlies the Dayton limestone, with the much thicker clay section of Maryland, identified by Prouty as Clinton. In this case, the West Union bed of northern Kentucky may be regarded as approximately equivalent to the lower part of the Rochester section, as identified by Prouty.

In the Maryland section, a ferruginous sandstone occurs in two beds, varying from several inches to six feet in distance apart, at an elevation varying from 120 to 160 feet above the base of the argillaceous section there identified as Clinton. It is not known whether anything corresponding to this lower ferruginous horizon occurs in Kentucky. It may be of interest, however, to note in this connection, that the iron ore of Bath county, Kentucky, traces of which extend into Fleming

county, is found immediately above the sandy layers containing *Whitfieldella subquadrata*, Foerste. The ore is overlaid at the Rose Run quarry by eight feet of Plum creek clay and five feet of Oldham limestone. The sandy layers containing *Whitfieldella subquadrata* appear to locate a stratigraphic break, distinctly sandy layers being rare in Silurian rocks in Kentucky or Ohio, and on this account the sandy rock with the overlying iron ore has been included with the overlying Crab Orchard formation, rather than with the underlying Brassfield bed.

It will be a subject of future inquiry to determine whether the Alger clay division of the Crab Orchard formation of Kentucky corresponds to all or only to the upper part of the Clinton of Maryland, as identified by Prouty.

The most interesting result, however, of this attempted correllation of the Silurian formations of Kentucky with those of Maryland is the conclusion that the low barrier separating the Cumberland gulf, containing the Maryland and eastern New York Silurian deposits, from the interior epicontinental sea, containing the Kentucky and Ohio Silurian deposits, was lowered several times during Silurian times. It must have been lowered during the deposition of the upper parts of the Alger clay, so as to permit of the entrance of *Calymene clintoni* into Kentucky. It probably was lowered again during the deposition of the lower part of the West Union bed, although *Dalmanites limulurus* and *Homolanotus delphinocephalus* occur abundantly in the Rochester shale of western New York. Some of the associated species, at Martins, in Kentucky, however, remind me more of Cumberland Gap and Alabama fossils than of those of western New York.

Again, during the deposition of the Waco limestones, an Atlantic fauna including *Calostylis* appears to have come in from some point eastward.

It should be stated, however, that this incursion of eastern faunas appears to have been local. The Waco fauna is confined practically to Madison, Estill, Powell and Clark counties.

in east-central Kentucky. The *Calymene clintoni* and *Beyrichia lata* fauna is confined practically to Lewis county, in Kentucky. The great numbers of *Dalmanites limulurus* and *Homolanotus delphinocephalus* appear restricted to a single locality in Lewis County: that exposed by the bluff northwest of Martins. Moreover, the barrier does not appear to have remained down long enough to permit any considerable part of the eastern faunas to enter Kentucky and Ohio during any one of the periods of deposition here mentioned. In each case only a small number of species is distinctly eastern, and the great majority remain western.

The Cedarville limestone of Ohio contains a distinctive Guelph element, and its Guelph affinities were recognized by Professor Orton. The fauna of the Springfield limestone is practically unknown.

Overlying the Hillsboro sandstone, in southern Ohio, is the Greenfield limestone, apparently the lowest member of the Monroe formation of Michigan and Northern Ohio.

At Kokomo, in north-central Indiana, at least forty feet of limestone are extensively quarried which are characterized by the evidence of very thin lamination of their bedding planes, often beautifully shown on weathered surfaces, and also by the presence of various eurypterids, or merostomata. This eurypterid horizon is overlaid by a series of limestones of more normal type, not thinly laminated, in which a rather rich brachiopod fauna is present. This brachiopod horizon should probably be distinguished from the eurypterid horizon by a distinct name, and the designation, Kokomo limestone, should be restricted to the eurypterid beds, but at present no suitable name is at hand. The eurypterid horizon, and probably also the overlying brachiopod horizon, are regarded as of Salina age. In New York, the Salina forms the lower division of the Cuyahogan.

It is impossible, at present, to determine what are the relations between the Greenfield limestone of Ohio and the Salina horizons at Kokomo. Both areas undoubtedly were connected

during early Cuyahogan times with lower Michigan, northern Ohio, and western New York.

At the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana, at present owned by Wilbur Defenbaugh, and run last by Charles Driggs, the following section is exposed:

Heavy bedded fossiliferous limestone.........	1 ft. 8 in.
Chert, thin bedded, with ostracods............	1 in.
Thin bedded fossiliferous limestone..........	2 ft.
Base of the brachiopod horizon.	
Darker layer of limestone....................	2 in.
Thin bedded limestone........................	10 in.
Heavier bedded limestone, but thinly laminated,	1 ft. 4 in.
Thin bedded limestone........................	9 in.
Darker limestone	3 in.
Layer with merostomata.	

At the McReynold or Interurban quarry, in the southwestern corner of Kokomo, there is a much thicker exposure of the upper or brachiopod horizon. No merostomata have been found here.

South of the center of Kokomo, within the town limits, there is a deep quarry, covering a considerable area, where merostomata are common at an elevation of three to three and one-half feet above the base of the quarry. This belongs to the lower thinly laminated part of the section, and the richly fossiliferous brachiopod beds appear to be absent. The base of the quarry must be at least thirty feet below the top of the exposures, but no measurements were made.

At the George W. Hawker quarry, now owned by Vess Guinn, a mile southwest of Kokomo, merostomata are said to occur ten feet below the top of the quarry. At the Chaffin quarry, they occur very low in the quarry, and about twenty feet below the top.

It is not improbable that several merostomata horizons occur in the thinly laminated limestones of the Kokomo region, and that different species occur at the different horizons. No

attempt has been made so far to collect any of these species by horizons.

The following descriptions of fossils are offered as an addition to our present knowledge of Silurian fossils at three horizons where at present our knowledge is most defective: the Kokomo limestone, the West Union limestone, and the top of the Alger division of the Crab Orchard limestone, which was included in Ohio by Orton under the term Niagara shale.

Amplexus septatus, sp. nov.

Plate I, Figs. 12 A, B.; Plate II, Figs. 16 A, B, C.

Corallum simple; no evidence of gemmation in the specimens at hand. Form conico-cylindrical or gently enlarging from the base. The largest specimen found so far has a length of about 60 mm., and a width of approximately 12 mm. at the top. The exterior is marked by comparatively strong vertical septal ribs of which six to seven, sometimes eight, occupy a width of 10 mm. Transverse striations and moderate annulations or constrictions also present. Transverse tabulæ comparativly flat, not deflected at the margins. Radiating septa differentiated into primary and secondary septa. Of these the primary septa extend for a distance of about 2 mm. from the exterior surface of the corallum toward the center, in specimens having a diameter of about 10 or 11 mm. The secondary septa frequently do not extend more than three-quarters of a millimeter from the exterior surface. This method of measurement is adopted since the wall of the corallum appears more or less thickened by the process of silicification in some specimens. Judging from other specimens, the thickness of the wall exceeds a quarter of a millimeter only slightly. The number of primary septa varies from eighteen to twenty-one in specimens about 10 mm. in diameter. There is an equal number of secondary septa. The transverse tabulæ vary in number from two to four in a length of 3 mm. In some specimens their number may be even less.

Kokomo limestone, in the upper part of the exposure at the old George W. Defenbaugh quarry.

Compared with *Amplexus cingulatus*, Billings, the septa are less numerous and extend farther toward the center of the corallum. The tabulæ are more nearly flat. The genus *Pycnostylus* differs in the compound growth of the corallum, the corallites forming colonies due to gemmation.

Favosites sp.

An unknown species with corallites 1.5 mm. in diameter, interspersed with rather numerous smaller corallites which probably are merely the initial stages of the larger ones. Septal spines and pores on the walls of the corallites are present. Tabulæ not well preserved.

West Union bed, one mile south of Carrs, in Lewis county, Kentucky.

A small globose specimen of *Favosites*, with corallites 1.5 to 2 mm. in diameter, with rather numerous tabulæ, occurs in the West Union bed northwest of Martins, in Lewis county, Kentucky.

Favosites pyriforme-kokomoensis.

Plate I, Figs. 17 A - D; Plate II, Fig. 15.

Corallum apparently small and globose, as far as may be determined from the fragment at hand. This fragment has a height of 26 mm., measuring from the point from which the corallites radiate. The presence or absence of an epitheca can not be determined. Corallites between 1.5 and 1.7 mm. in diameter, occasionally equalling almost 2 mm. Cross-section of the corallites, polygonal; walls thin, but thickened during the process of silicification in a part of the specimen. Pores large and distant, with elevated margin, apparently with a tendency toward arrangement in vertical rows, one row on each wall of the corallite. Diameter of pores estimated at 0.2 mm., and the vertical distance between them varies from 0.4 to 0.7 mm. They have a tendency to occur so that several are found at about the same level. Septal spines apparently short, not exceeding a third of a millimeter in length, as far

as may be determined in the present silicified condition of the fragment here described. They tend toward arrangement in vertical rows, varying apparently from six to twelve in number; from three to four spines occupy a length of 1 mm. Tabulæ present, apparently from 1.2 to 1.7 mm. apart, where preserved.

Kokomo limestone at Kokomo, Indiana, in the upper part of the exposures at the old George W. Defenbaugh quarry.

This specimen appears to be closely related to *Favosites pyriforme*. This relationship is shown by the spheroidal form, small size of the corallites, and the presence of the septal spines. In the Kokomo specimen, however, the spines appear short, not bent upward at the tip, and the pores are so large that it seems difficult to believe that they could have escaped attention in the New York specimens if of equal size there. Probably the Kokomo specimen should be regarded as a variety of *Favosites pyriforme*.. A fuller description of the New York species is needed.

Halysites catenularia, *Linnæus.*

Specimens with corallites 2 mm. wide along their greater diameter; the tubules between the corallites are crossed by numerous closely set and strongly arched tabulæ. Found in the West Union bed at the Clarksburg chapel or Church of Christ, three miles south of Vanceburg, on the road to Valley, in Lewis county, Kentucky.

Halysites nexus, *W. J. Davis.*

A variety with four corallites in a width of 15 mm. occurs in the upper part of the George W. Defenbaugh quarry, southeast of Kokomo, Indiana. It appears to be identical with the form figured by W. J. Davis, on plate 67 of Kentucky Fossil Corals as *Halysites nexus*.

Cornulites clintoni, *Hall.*

A small fragment of this species was found in the West Union bed, at the spring one mile south of Glen Springs, on Big Salt Lick creek, in Lewis county, Kentucky.

CLATHROPORA FRONDOSA, *Hall.*

A wretchedly preserved specimen showing the fenestrules occurs in the West Union bed at the spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Ky.

RHYNCHOTRETA AMERICANA, *Hall.*

Similar to *Rhynchotreta americana* from the Waldron clay of Indiana, but in some specimens the beak is less prolonged, although equally acute. In some specimens the two middle plications on the median fold are conspicuously more elevated than the other two, but in others all four plications on the fold reach about the same elevation. Sinus of the pedicel valve with three plications. Lateral plications usually three, but sometimes two or four.

West Union bed, in the quarry at the southeastern corner of West Union, Ohio. Also at the spring on Big Salt Lick creek one mile south of Glen Springs, and one mile south of Carrs station, in Lewis county. At the locality south of Carrs, an aberrant specimen was found with two plications on the fold, one in the sinus, and two lateral plications on each side of the fold and sinus.

CAMAROTOECHIA CONGRUENS, **sp. nov.**

Plate II, Figs. 3, A, B.

Shell small, 6 mm. long, 6.5 mm. wide, both valves moderately and rather evenly convex. Four plications occupy the median fold of the brachial valve, and about eight lateral plications are found on each side. The most characteristic feature is the very low elevation of the median fold, in some cases almost imperceptible, combined with the slight difference in size of the plications occupying the median fold and those immediately adjacent. While usually the plications on the fold are slightly larger, in some cases the difference is almost imperceptible.

In the upper part of the Alger clay division of the Crab Orchard formation, between Valley and the W. H. Lawrence store, in Lewis county, Kentucky.

The nearest relative of this shell appears to be *Camarotoechia indianensis*, but that species attains a larger size, the plications appear coarser, and the shell usually is more or less flattened anterior to the beak.

Similar shells occur in the West Union bed, northwest of Martins, in Lewis county, Kentucky. They attain a length of 7 mm., a width of 8.5 mm., with a depth of about 3.5 mm. There are about 14 radiating plications, of which the median four are slightly elevated in case of the brachial valve, while the median three of the pedicel valve are slightly depressed below the general level.

CAMAROTOECHIA ACINUS-SUBRHOMBOIDEA, **var. nov.**
Plate II, Fig. 4.

A small rhynchonelloid, 6.5 mm. long, and 6 mm. wide, not strongly flattened on the sides, and having an ovate-subrhomboidal, rather than elongate ovate outline. The plications limiting the median sinus of the pedicel valve form angles varying from thirty to forty-five degrees. The sinus is very shallow, and is marked along the anterior half of the internal cast by a single plication. In addition to the plications limiting the sinus, there is, on each side of the internal cast, one lateral plication, indistinct toward the posterior half of the shell, and a trace of a second lateral plication in some specimens.

West Union bed, northwest of Martins, in Lewis county, Kentucky.

This form is distinguished from *Camarotoechia acinus* chiefly by the absence of lateral flattening and the smaller number of lateral plications.

CAMAROTOECHIA PISA ? , *Hall and Whitfield.*
Plate II, Figs. 1 A, B.

A small specimen of a very globose rhynchonelloid may be a diminutive representative of the species *Camarotoechia pisa.* Its length is 7 mm., its width 7.2 mm., and the depth 6.5 mm. There are four plications on a very low fold, the

anterior part of which follows the general convex curvature of the shell. Three plications occupy the very shallow sinus. There are five lateral plications on each side, which are indistinct over the middle and posterior parts of the cast. The anterior slope of the shell is fairly abrupt. There is a distinct median septum in the brachial valve, and there are traces of dental plates in the pedicel valve.

West Union bed, northwest of Martins, in Lewis county, Kentucky.

This shell is much smaller than *Camarotoechia pisa*, as figured by Hall and Whitfield, and may have come from a different horizon.

Wilsonia kokomoensis, *Miller.*

Described from Kokomo, Indiana, but not found by the writer.

Atrypa reticularis-niagarensis, *Nettelroth.*

A single valve, 10 mm. in length, with six radiating plications in a width of 5 mm., was found at Harin Hill, four miles west of Valley, also at the Clarksburg chapel, three miles south of Vanceburg, in Lewis county, Kentucky, in the West Union bed.

Atrypa rugosa, *Hall.*

Plate II, Fig. 6.

A cast of the external surface of the pedicel valve, 10 mm. long. A single plication occupies the sinus. The plications bordering the sinus are rather prominent and bifurcate near the anterior end, but the bifurcations remain close together. Next, on each side, comes an intercalated plication, then a primary plication bifurcating distinctly toward the end, the bifurcations spreading considerably. Then, another intercalated plication, followed by a primary plication, and one or two smaller plications near the anterolateral margin. The characteristic feature is the presence of both bifurcating primary and intercalated secondary plications.

West Union bed, at the quarry in the southeastern part of West Union, Ohio.

Coarser specimens, with several plications in the sinus, and with rather strong and distant concentric striations, in the Osgood bed of Indiana, are more nearly related to *Atrypa calvini*, Nettelroth, from the Louisville limestone in the vicinity of Louisville, Kentucky. *Atrypa marginalis*, as identified from the Brownsport formation of western Tennessee, belongs to the same group.

Spirifer radiatus, *Sowerby*.

Plate II, Fig. 8.

An internal cast of the pedicel valve of a nonplicate form of *Spirifer*, with a rather quadrate outline posteriorly, and with a distinctly defined median sinus. Length 15 mm., width 19 mm. Dental plates continuing for 5 mm. from the beak. Apparently a trace of a median septum.

West Union bed, at the bluff northwest of Martins, in Lewis county, Kentucky.

Spirifer radiatus-obsoletus, **var. nov.**

Plate II, Figs. 10 A, B, C.

Spirifer belonging to the group typified by *Spirifer radiatus*, differing chiefly in the nearly complete obsolescence of the median sinus and fold. In a specimen 22 mm. in length, 48 mm. in width, and 17 mm. in thickness, the sinus is indicated only by a slight flattening of the anterior part of the pedicel valve, while the fold is represented by a broad but only slightly elevated median part which is not distinctly limited laterally, as in *Spirifer radiatus*. However, there are specimens from the same locality in which there is a narrower slightly elevated median part with a distinct lateral boundary. These specimens evidently indicate the close relationship of this form to typical *Spirifer radiatus*. The interior of the pedicel valve exhibits two dental lamellæ extending from 8 to 10 mm. anterior to the beak, and also a low acute median septal ridge

extending one or two millimeters farther. The crural plates of the brachial valve are short, nearly vertical, and only moderately divergent; there is no distinct median septum in this valve. In the type specimen there are about eleven radiating striæ in a width of 5 mm. at a distance of 17 mm. from the beak of the brachial valve, but in some specimens the number of striæ is greater, so that the smaller number of radiating striæ seen in the type specimen does not seem to be a constant feature. The anterior of the shell is deflected so as to indicate the relationship of this form to shells with a distinct sinus and fold.

West Union bed, at the spring on Big Salt Lick creek, one mile south of Glen Springs, on the road to Noah, in Lewis county, Kentucky.

The sharp median septum of the pedicel valve has not been noted in typical forms of *Spirifer radiatus.* The beak appears to be somewhat less incurved. The most conspicuous difference, however, is the absence of a distinct median sinus, giving the pedicel valve a more evenly convex surface.

Spirifer nanus, sp. nov.

Plate I, Fig. 7; Plate II, Fig. 7.

Shell apparently small, the largest specimens found not exceeding 10 mm. in length, 11 or 12 mm. in width, and 4 mm. in convexity. Considering the size of the shell, the brachial valve is strongly convex, especially along the median fold. Only the internal casts of the brachial valve have been found so far, and these show the presence of the crural ridges, about 2 mm. in length, and also a faint median septal striation, about 5 mm. in length. If our interpretation of the shell be correct, it may be related to the form represented by figures 14 to 18 on plate 21, Volume VIII, of the New York Paleontology. In our specimens, however, the median fold is less distinctly limited, especially toward the beak, where it is but slightly elevated above the general convexity of the shell. There are no traces of radiating striæ on these casts.

West Union bed, at the spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky, on the road to Noah. Also at the same horizon in the quarry southeast of west Union, in Adams county, Ohio.

At first glance the shell does not have a strongly spiriferoid appearance, and the casts of the pedicel valve will be necessary to make the generic reference certain. Externally, it resembles *Hyatella congesta,* but its internal structure is different.

SPIRIFER EUDORA, *Hall.*

Plate II, 14 A, B.

A small form of *Spirifer eudora*, 15 mm. in length. Sinus and fold distinct, the latter flattened on top anteriorly, and slightly depressed along the median line. Four lateral plications on the brachial valve, and four on each side of the sinus in the pedicel valve. One specimen with traces of longitudinal striations.

West Union bed, in the quarry at the southeastern corner of West Union, Ohio.

SPIRIFER REPERTUS, **sp. nov.**

Plate I, Figs. 14 A, B; Plate II, Fig. 5.

This species evidently belongs to the group typified by *Spirifer niagarensis.* From this it differs chiefly in being smaller, shorter, and having fewer radiating plications. Of these there are seven on each side of the median fold in a brachial valve 11 mm. long and 20 mm. wide. The convexity of this valve was about 3 mm. The grain of the rock is not fine enough to preserve any trace of the delicate longitudinal striations characteristic of this group of species.

West Union bed, at Harin Hill, four miles west of Valley, in Lewis county, Kentucky. Also at the same horizon at the quarry in the southeastern corner of West Union, Ohio.

SPIRIFER HARINENSIS, **sp. nov.**

Plate II, Fig. 2, A. B.

Shell small, 5 mm. in length. The fold of the brachial valve is low but is distinctly limited laterally by grooves

extending as far as the beak. On each side there is a single, much less distinct lateral plication. Beyond this, there is room for an additional plication, but this area is smooth. The sinus of the pedicel valve is distinct as far as the beak, and the limiting plications may be traced the same distance. Beyond the latter, there is a much less distinct plication, disappearing posteriorly. The surface does not preserve any indication of striæ, but may not be fine grained enough to preserve them.

West Union Bed, at Harin Hill, four miles west of Valley, in Lewis county, Kentucky.

The presence of distinct dental plates in the casts of this species separates it from *Reticularia*, entirely aside from the fact that no evidence of strong fimbriate concentric striæ has been discovered. It appears to belong to the *Spirifer vanuxemi* type of shells. *Spirifer simplex* is a distinctly more globose, and more strongly plicate shell.

Spirifer exiguus, sp. nov.

Plate I, Figs. 8, A, B, C.

Shell small. The largest specimen found so far equals 9 mm. in length, 10 mm. in width, and 6.4 mm. in thickness; the length of the brachial valve is 8 mm. and the width of the median fold at the anterior margin is 3 mm. The brachial valve is moderately convex. The median fold is low and broad, but is distinctly defined on each side by the limiting grooves; anteriorly it is flattened, with occasionally a very faint trace of a median depression. Lateral plications four, usually faint, the first occasionally distinctly broader than the rest, the second still fairly discernible, the last two almost obsolete. Median groove of the pedicel valve shallow, not angular or narrow; the limiting plications are distinctly more conspicuous than the lateral plications, being both broader and more elevated. Lateral plications faint, four in number, the last two almost obsolete. Hinge area rather low. Beak of the pedicel valve strongly incurved but not extending beyond

the plane of separation of the valves. All lateral plications on both valves become more or less indistinct or obsolete toward the beak. Surface smooth, with no distinct evidence of concentric striæ. Dental plates high near the beak, rapidly thinning to their anterior extremity, about 3mm. from the most elevated part of the beak, divergent at an angle of about twenty degrees.

Kokomo limestone, at Kokomo, Indiana, near the top of the exposures at the George W. Defenbaugh and Traction quarries.

Compared with *Spirifer vanuxemi*, the beak is less elevated, the shell is less angular laterally, and the lateral plications are much less distinct. Compared with *Spirifer eriensis*, Grabau, the absence of a subrhomboidal outline, of a high area, and of a pronounced angular median sinus are sufficient characteristics. Compared with *Spirifer corallinensis*, Grabau, the wider median sinus, more rounded outline, and the presence of lateral plications, though faint, are sufficient characteristics. Compared with *Spirifer bicostatus*, the beak is less elevated, the lateral plications are more narrow, and the concentric striæ are practically obsolete.

Spirifer corallinensis, *Grabau*.

Several small and relatively wide Spirifers, with a narrow fold and sinus, but without any indications of lateral folds, were found at the Traction quarry in the southwestern part of Kokomo, Indiana. These can not be distinguished from the Spirifers represented by figures 9 a-h, on plate 74, volume 2, of the New York Paleontology.

Trematospira camura-pauciplicata.

Plate II, Figs. 9 A, B.

A pedicel valve, 6.5 mm. in width, and 4.5 mm. in length, with two low and narrow central plications, and four strong and angular lateral plications, resembling figure 24 on plate 49, volume VIII, of the Paleontology of New York, but of

much smaller size, occurs in the West Union bed in the quarry in the southeastern corner of West Union, Ohio. These specimens agree fairly well with some of the pauciplicate forms illustrated by Hall, in volume 2 of the Paleontology of New York, but not with the multiplicate forms illustrated by Hall and Clarke in volume 8 of the same series. As far as may be determined by a comparison with the figures accompanying the original description, our specimen is more strongly plicated.

WHITFIELDELLA NITIDA, *Hall.*

Specimens not exceeding 15 mm. in length; the cast of the brachial valve marked by a distinct median septum extending 3 mm. from the beak; the cast of the pedicel valve showing the presence of two vertical dental lamellæ, without any strongly developed muscular impressions. A faint median depression marks the anterior margin of the pedicel valve.

West Union bed, at the spring on Big Salt Lick Creek, one mile above Glen Springs, and at Harin Hill, four miles west of Valley, in Lewis county, Kentucky. Also at the quarry in the southeastern part of West Union, Ohio.

WHITFIELDELLA ERECTA, **sp. nov.**

Plate I, Figs. 9 A, B, C.

Shell small. The largest specimen found so far has a length of 9 mm., a width of 9.5 mm., and a thickness of 4.5 mm. The outline of the pedicel valve is rounded ovate; that of the brachial valve is more nearly circular. The valves are approximately equally convex, the convexity being moderate in the case of smaller valves but increasing with age. A median depression becomes distinct about 3 mm. from the beak and increases in width and depth anteriorly, though remaining rather shallow and comparatively narrow. Most of the brachial valves are evenly convex, but occasionally a valve is found which has a faint median depression anteriorly. The beak of the pedicel valve is short and erect; it does

not curve over the beak of the brachial valve, but exposes the unclosed triangular delthyrium. The surface of the shell is smooth. The number of volutions of the spires forming the brachidium is about 7; the remainder of the brachidium has not been observed.

Kokomo limestone at Kokomo, Indiana; common in the Traction quarry, but found also in the old George W. Defenbaugh quarry.

The exposure of the delthyrium even in mature specimens is the chief diagnostic characteristic of this species, although this feature is shared by *Whitfieldella didyma* from the Silurian of Gotland. This characteristic probably will serve to distinguish the Kokomo species from *Whitfieldella nucleolata*, which it otherwise resembles. The more conspicuous depression along the median part of the pedicel valve, anteriorly, and the absence of concentric striæ also are distinguishing features.

Anoplotheca congregata, *Kindle.*

A small species of *Anoplotheca*, differing from the form described by Kindle from Logansport, Indiana, only in its much smaller size, occurs abundantly in the Traction quarry, and in smaller numbers also in the upper part of the old George W. Defenbaugh quarry, at Kokomo, Indiana.

Leptaena rhomboidalis, *Wilckens.*

Width 22 mm., length estimated at 13 mm.; with 11 or 12 concentric wrinkles, of which the anterior 4 or 5 are rather prominent. Six or seven radiating striæ in a width of 2 mm.

West Union bed, at the bluff northwest of Martins, also at Harin Hill, four miles west of Valley, in Lewis county, Kentucky. A similar specimen, from the spring a mile south of Glen Springs, on Big Salt Lick creek, appears to be more coarsely striated.

A very small form of *Leptæna rhomboidalis*, about 12 mm. in width, occurs both at the Traction and at the old George W. Defenbaugh quarry, at Kokomo, Indiana.

STROPHEODONTA MUNDULA, sp. nov.
Plate II, Fig. 18.

Brachial valve concave, pedicel valve convex. Width about 14 mm., length 9 mm., depth approximately 2 to 2.5 mm. Surface covered with very fine radiating striæ, visible under a lens, of which some at more or less regular intervals are more conspicuous. Of the latter there are about 9 in a width of 4 mm. near the anterior margin.

Cardinal process not preserved. Immediately in front of the position which should be occupied by this process there is a thickened area 1.3 mm. in width which narrows anteriorly to a median ridge about a third of a millimeter in width, and which thickens again slightly toward the end. This ridge may be traced to a point 6 mm. from the beak; slightly over 7 mm. from the beak the valve, as seen from the interior, is deflected downward and this marginal part preserves the traces of vascular markings. From the broad, thickened area near the beak one very divergent low ridge extends off on each side at an angle of about 20 degrees with the hingeline, limiting the posterior part of the posterior diductor impressions. These are separated from the anterior diductor impressions by indistinct ridges which extend from the same broad, thickened area near the beak forward at an angle of about 25 degress with the median line. The anterior part of the anterior diductors may be traced to a point about 3 mm. from the hingeline, while the posterior diductors extend to a point about 2 mm. from this line. Corresponding to the indistinct ridge between the anterior and posterior diductors, an irregular ridge extends forward and becomes thickened and more conspicuous anteriorly. It may be traced, on each side of the valve to a point 5 mm. from the beak. The thickened terminations of the two divergent ridges just described, and that of the median ridge form characteristic features of this species. The space between these terminations and as far back as the hinge line is distinctly granulose or papillose, as in the interior of *Strophomena vetusta.* Indistinct traces of

minute denticulations along the hingeline appear to occur. The affinities of this species are believed to be with *Brachyprion*.

Geological position: In the upper part of the Crab Orchard clay shales, between Poplar Flats and Martin's store, in Lewis County, Kentucky, in the same slab with *Calymene clintoni*, *Beyrichia lata-triplicata*, *Chonetes vetusta*, and *Camarotoechia congruens*.

STROPHEODONTA (BRACHYPRION) PLANUS, **sp. nov.**

Plate I, Figs. 13 A, B, C; Plate II, Figs. 11 A, B.

The largest specimen found so far has a length of 25 mm. and a width of 31 mm. The convexity of the pedicel valve is about 3 mm. The brachial valve is unknown, but is assumed to be practically flat or slightly concave. The pedicel valve is gently and evenly convex in small specimens, becoming flatter near the anterior margin in larger specimens. The postero-lateral angles vary from 80 to 90 degrees. The dental lamellæ are continued anteriorly as conspicuous ridges limiting the postero-lateral boundaries of the muscular area. Anteriorly, they disappear entirely, and here the boundaries of the muscular area are uncertain. A distinct median low septal ridge is present in all specimens. Usually it extends as far from the cardinal margin as the dental ridges, or a little farther. At the beak this median ridge is distinctly wider. Radiating striæ fine, about 8 or 9 in a width of 2 mm., subequal, except where other striæ are intercalated, and here they are alternately larger or smaller.

West Union bed, at the bluff northwest of Martins, and at Harin Hill, 4 miles west of Valley, in Lewis county, Kentucky. Also at the same horizon in the quarry at the southeastern edge of West Union, Ohio.

This species is distinguished from *Stropheodonta orthididea* by the presence of the median septal ridge in the pedicel valve, the less orthoid appearance of the muscular area owing to the absence of any distinct anterior boundary, and

also the absence of fasciculation among the radiating striæ. Its relations to the species described by Hall as *Strophcodonta prisca* are unknown, but Whitfield and Hovey interpret the type specimen as an imprint of the ventral valve of a species of *Strophonella*. In that case our specimens are distinct.

SCHUCHERTELLA CONFERTUS, sp. nov.

Plate II, Figs. 13 A, B.

Shells attaining a length of 18 mm. and a width of 26 mm.; very flat and thin. The pedicel valve is gently and evenly convex, the convexity usually not exceeding 2 mm. The brachial valve is almost flat, the convexity toward the beak being almost imperceptible; occasionally, it is even slightly concave. The postero-lateral angles vary from 75 to 90 degrees. The dental lamellæ diverge at an angle of 75 to 85 degrees and extend between 1.5 and 2 mm. beyond the hinge-line. There is no evidence of a broad deltidium arching over the delthyrium. Muscular area not distinctly outlined. Crural ridges of the brachial valve distinct, forming a crescent-shaped elevation. At the beak there are two, apparently rather narrow elevations which represent the cardinal process. The surface of the shell is marked by numerous radiating striæ, of which there are 5 in a width of 2 mm. at a distance of 10 mm. from the beak; in larger shells the number may be reduced to 6 in a width of 3 mm. These striæ are subequal in size except at those distances from the beak at which additional striæ are intercalated, where the striæ are alternately larger and smaller.

West Union bed. In the bluff northwest of Martins, in Lewis county, Kentucky.

The generic relations of this shell are uncertain. The very distinct convexity of the pedicel valve, and the flatness or even slight concavity of the brachial valve apparently exclude it from any close relationship with *Schuchertella subplanus*, in which it is the brachial valve which is distinctly convex and in which the pedicel valve is distinctly less con-

vex, especially anteriorly. Nevertheless, the general appearance and structure of our specimens appear to correspond more nearly to that of *Schuchertella subplanus* than to that of any other genus. The strong dental lamellæ exclude it from *Stropheodonta;* moreover, there is no evidence of crenulations along the hinge line. The strong crural ridges are unknown in *Rafinesquina;* moreover, the dental lamellæ are too long, and the faint indications of the muscular areas in both valves are not in favor of such a relationship.

Our specimens apparently agree with the species originally described as *Leptæna obscura*, by Hall, in the slight convexity of the pedicel valve, and in the general outline. Moreover, figure 6a on plate 21 of volume 2 of the Paleontology of New York apparently agrees also in the coarseness of the radiating striations. Unfortunately this type has been lost, and the associated figure on the same plate, figure 6b, indicates a form with much shorter and less conspicuous dental lamellæ, and the reference of this form to *Rafinesquina* suggests entirely different generic affinities.

CHONETES VETUSTUS, *Foerste.*

Plate I, Fig. 16.

This species attains a width of 9 mm. and a length of 6 mm. There are about 60 to 70 radiating striæ. Compared with *Chonetes cornutus*, our specimens are wider, have more numerous striæ, and the hinge spines are more inclined and relatively shorter.

Near the top of the Alger clay at numerous localities in Lewis county, Kentucky. The types were found between Valley and the W. H. Lawrence store.

CHONETES COLLICULUS, **sp. nov.**

Plate I, Figs. 10 A, B, C.

Shell small. The largest specimen found so far has a width of 8 mm. and a length of 6.5 mm. Pedicel valve strongly convex. In shells 7 mm. in width this convexity usually does not exceed 2 mm., but in the more mature shells it may equal

fully 3 mm. The general outline of the shell is semi-circular, the width being greater near the hinge line than across the middle of the shell. The convexity of the pedicel valve is greatest along the median parts of the shell, producing a semi-globose area in the more convex specimens, beyond which the postero-lateral parts project with a more or less concave outline when viewed from the side of the hinge area. Radiating striations 10 in a width of 2 mm. at a distance of 3.5 mm. from the beak; this results usually in about 40 striations within 4 mm. of the beak, although in the more convex specimens the number of radiating striations may increase to 50. Concentric striations are fine, close, and not conspicuous even when seen under a lens. A vertical spine one millimeter in length is located about 1.5 mm. from the middle line of the shell on each side of the beak. A slightly longer spine, inclining outward at an angle of 35 to 45 degrees, is located about 2.5 mm. from the middle line, on each side of the beak. In one specimen spines were found three and a quarter mm. from the middle line, but it has been impossible so far to distinguish more than 4 spines on the same shell.

Kokomo limestone at Kokomo, Indiana; common in the upper part of the exposures at the Defenbaugh quarry.

Compared with *Chonetes cornutus, Chonetes novascoticus, Chonetes tenuistriatus*, and *Chonetes jerseyensis*, the distinctly greater width near the hinge line, compared with the width across the middle of the shell, is a distinguishing feature. Moreover, the convexity of the pedicel valve is considerably greater. Compared with *Chonetes undulatus*, the convexity is greater, and the radiating striations are much more numerous.

Platystrophia pauciplicata, sp. nov.

Plate I, Fig. 15.

This specimen of *Platystrophia* is distinguished by the presence of only two plications on the median fold, and three plications on each side of this fold, with a faint indication

of a fourth plication near the hinge line. The hinge line is distinctly shorter than the width of the shell across the middle. The crural plates are strongly developed, and the ridge in the cavity between these plates, representing the cardinal process, is distinctly indicated by a depression along the middle of the cast of this cavity, as presented by the specimen figured, but this depression is not indicated in the accompanying drawing.

West Union bed, in the quarry in the southeastern corner of West Union, Ohio.

Since only a single specimen of *Platystrophia* was found, it is doubtful whether an even number of plications is a constant feature of this species. However, the greatly reduced number of lateral plications is probably a feature which may be expected in other specimens from the same locality.

A single, poorly preserved specimen of *Platystrophia*, from the Osgood bed, south of Nebraska, Indiana, shows 3 plications in the sinus and 7 or 8 lateral plications on each side. No other specimens from this horizon are at hand.

In the Waco limestone member of the Crab Orchard formation, at Waco, Irvine, and Panola, in Kentucky, the variety *Platystrophia reversata*, Foerste, is represented by specimens beginning with two plications in the sinus, increasing to from 5 to 8 plications on the larger individuals.

Platystrophia is cited by Orton from the Springfield limestone, at Springfield, Ohio. It is not known from the Waldron bed of Indiana, Kentucky, or Tennessee. In the lower part of the Louisville limestone it is represented by a medium-sized species with 5 plications on the fold of mature specimens, with 7 lateral plications on each side. *Platystrophia* occurs also in the Louisville limestone at Bledsoe, in Tennessee. It has not been found at any horizon in the Brownsport formation.

Platystrophia is fairly common in the Clinton or Brassfield limestone of Ohio, Indiana and Kentucky, and occurs much more sparingly in the overlying Osgood and Crab

Orchard clays and limestones. Above this horizon, in the states mentioned, is it a rare fossil.

One mile south of Carrs, in Lewis county, Kentucky, a single specimen with three plications on the fold, and with five lateral plications was found, probably in the West Union bed. This is similar to the form called *Platystrophia daytonensis.*

Dalmanella elegantula, *Dalman.*

Small, poorly preserved specimens, 4.5 mm. in length, are found in the West Union bed at Harin Hill, 4 miles west of Valley, in Lewis county, Kentucky.

Another small variety occurs at both the George W. Defenbaugh and the Traction quarry, in Kokomo, Indiana.

Rhipidomella magnicardinalis, sp. nov.

Plate I, Figs. 11 A-D; Plate II, Figs. 12 A, B.

Shell with a length of 12 mm., a width of 15 mm., and a depth of 9 mm. Both valves evenly and rather strongly convex. Hinge line distinctly shorter than the width across the middle of the shell. Postero-lateral angles rounded. General outline of the shell nearly circular. Radiating striæ rather coarse, about 10 or 11 in a width of 5 mm. along the antero-lateral margin, less numerous directly in front. Muscular area of the pedicel valve deeply impressed, flabelliform, occupying about half the length of the shell. Dental plates short but strong. Crural plates of the brachial valve strong, divergent, pointed, separated by a strong cardinal process which begins a short distance anterior to the bases of the crural plates, and extends back for a length of fully 4 mm. For half its length it projects as a strong process beyond the cardinal area of the brachial valve into the space beneath the beak of the pedicel valve. At the tip the process becomes broader than at mid-length, and apparently is supplied with three vertical ridges. Owing to the preservation of the shell in the form of casts, it has been impossible to decipher a part of its structure, but the deeply impressed muscular area

of the pedicel valve, and the remarkably long cardinal process of the brachial valve, together with the strong crural plates, are distinctly shown. Anterior to the cardinal process the shell is thickened interiorly, forming a rather wide though low elevation, narrowing anteriorly, and disappearing before reaching the middle of the valve.

West Union bed, at the Spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky.

The very strong and prolonged cardinal process suggests that of some forms of *Triplecia*, but it is not divided anteriorly, and the deeply impressed muscular area of the pedicel valve gives unmistakable evidence of the real affinities of this shell.

PENTAMERUS DIVERGENS, **sp. nov.**

Plate I, Figs. 5 A-E; Plate II, Figs. 17 A, B.

Shell rather small. In one specimen, preserving both valves but considerably deformed by pressure, the length of the brachial valve is 26 mm.; the width, 18 mm.; the length of the pedicel valve is estimated at 29 mm.; and the original thickness of the complete shell, at 10 or 11 mm. The general outline of the shell is ovate. The anterior outline is rounded, and the postero-lateral margins are flattened and converge toward the beak. This flattening is most conspicuous in case of the pedicel valve, where it results in a strong lateral compression of the posterior parts of the valve. The anterior margin of the shell is rounded, occasionally with a faint indication of the trilobation seen in other species of this genus. In the deformed specimen, mentioned above, the middle third of the brachial valve is raised slightly above the remainder. The margins of the delthyrium of the pedicel valve slope backwards from the plane of separation of the valves at angles varying from 45 to 60 degrees, causing the beak of this valve to be divergent from the remainder of the shell. The brachial valve is moderately convex, the beak curving over the lower part of the delthyrium of the pedicel valve.

The spondylium of the pedicel valve encloses a long, narrow, and deep cavity extending to within one-third of the length of the shell from the anterior margin. This spondylium is supported by a median septum extending almost to the anterior edge of the valve.

The interior of the brachial valve is marked by two sharp septal ridges, only moderately divergent anteriorly, extending fully a third of the length of the shell from the beak. Near the anterior part of the space between these septal ridges, a third septal ridge begins, extending to within a third of the length of the valve from the anterior margin. Posteriorly, the two septal ridges first mentioned become elevated into septal plates, supporting the crural plates. In a specimen, etched by means of acid, the top of the septal plates curves smoothly into the crural plates, there being no evidence of the former extension of the inner margins of the crural plates beyond the line of junction with the septal plates. The exterior margin of the crural plates defines the inner margin of the dental sockets. Enclosed by the two septæ, the crural plates, the remainder of the hinge plate, and the posterior part of the valve are two cavities, one on each side of the shell. Immediately in front of the beak, there is a thickening of the posterior part of the crural plates, extending in a semi-lunate fashion around the posterior extremity of the depression limited by the septal plates already described. This semi-lunate thickening, indistinctly defined posteriorly, apparently is part of the cardinal process.

Kokomo limestone, at Kokomo, Indiana, near the top of the exposures at the Defenbaugh and Traction line quarries.

Compared with *Pentamerus pes-ovis*, Whitfield, from the Greenfield limestone in Adams county, Ohio, the beak of the pedicel valve is less incurved at its extremity, and the septal plates of the brachial valve are less distant from each other. Moreover, the size of the Kokomo species is distinctly larger, although apparently it is closely related to the Greenfield limestone specimens described by Whitfield.

CONCHIDIUM COLLETTI, *Miller.*

Common in the upper part of the old George W. Defenbaugh quarry, in the southeastern part of Kokomo. Indiana.

DIAPHOROSTOMA CLIFTONENSIS, *Foerste.*

Several specimens closely related to *Diaphorostoma cliftonensis*, but less strongly elevated, occur in the West Union bed northwest of Martins, in Lewis county, Kentucky.

ISOCHILINA PANOLENSIS, *Foerste.*
Plate I, Fig. 1.

In the Waco limestone member of the Crab Orchard formation, at Panola and Irvine, Kentucky.

ISOCHILINA MUSCULOSA, **sp. nov.**
Plate I, Fig. 2.

Carapace large, in one specimen with a length of 8 mm. A better preserved right valve has a length of 6.5 mm., a height of 4.6 mm.; the length of the hingeline is 4 mm.; the center of the muscular tubercle is 2.3 mm. from the anterior margin and 1.5 from the dorsal margin. Anterior to the muscular tubercle is a second tubercle, half a millimeter in width and slightly over a millimeter in length. A faint striation crosses the middle of the second tubercle and extends toward the antero-dorsal angle of the valve. Between this striation, the second tubercle, and the dorsal margin, the carapace is slightly elevated, an additional but very narrow elevation occurring at the extreme antero-dorsal angle of the body of the valve. From the groove surrounding the muscular tubercle, vascular markings radiate, chiefly toward the ventral margin. A deep depression is on the postero-dorsal side of the muscular tubercle, and a short, narrow, low elevation is found along the groove extending postero-dorsally from this depression. A narrow marginal border extends around the anterior, ventral, and posterior sides, widening posteriorly.

Kokomo limestone, in the thin-bedded cherty layers at the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana.

Closely related to *Isochilina grandis-latimarginata,* Jones, but distinguished by the much more oblique postero-dorsal margin, the less extended anterior margin, and the distinct tubercle immediately anterior to the muscular tubercle.

BEYRICHIA LATA — TRIPLICATA, *Foerste.*

Plate I, Fig. 4.

Closely related to *Beyrichia lata,* Hall, from the Clinton at New Hartford, in Oneida county, New York, where that species occurs both in the ferruginous shale associated with the iron ore and in the underlying ferruginous sandstone. *Calymene clintoni* occurs in the iron ore beds in Herkimer county, and in the overlying shale in Cayuga county. *Homoianotus* and *Dalmanites* occur as low as the ferruginous sandstones associated with the iron ore at New Hartford. *Beyrichia lata-triplicata* occurs associated with *Calymene clintoni,* Vanuxem, in the upper part of the Crab Orchard shales at numerous localities in Lewis county, Kentucky. The types were found between Valley and the W. H. Lawrence store.

Beyrichia lata-triplicata: anterior margin less convex than the posterior margin, with the greatest curvature nearer the ventral margin. The ventral margin usually distinctly curved but sometimes more or less straightened along the middle. Anterior lobe large, ovate, distinctly connected at the base with the attenuated lower end of the narrow middle lobe. The posterior lobe in some specimens appears to unite at the base with the anterior lobe, in others its attenuated base appears to continue for a short distance beyond the point of junction of the other two lobes. The highest part of the posterior lobe forms a ridge immediately in front of the furrow separating the posterior and middle lobes. From this ridge the surface of the posterior lobe slopes toward the

furrow limiting the narrow marginal border. The groove between the posterior and middle lobes is only slightly narrower than that between the middle and posterior lobes. Considering the amount of variation shown by the specimens found in Lewis county, it is doubtful whether the specimens from the Crab Orchard beds of Kentucky are to be considered distinct from the typical *Beyrichialata* from the Clinton of New York.

Kloedenia kokomoensis, sp. nov.

Plate I, Figs. 3 A, B.

Carapace small, length 3 mm., height 1.7 mm. Ventral edge nearly parallel to the dorsal, the height of the carapace increasing slightly posteriorly. Left valve with a vertical groove about 1.3 mm. from the anterior end, extending for more than half the distance to the ventral margin. Posterior to this groove is a small, globose lobe, similar to that of *Kloedenia sussexensis*, Weller, but more distant from the dorsal margin. Posterior to this middle lobe is a groove, the center of which is about 2 mm. from the anterior margin of the carapace. Ventrally the middle lobe is not well differentiated from the remainder of the carapace, and the groove bordering this lobe on the posterior side is less distinct than that on its anterior. Near the dorsal margin, the posterior edge of the lobe is slightly elevated. A broad and relatively steep marginal area borders the ventral margin; it is less conspicuous along the anterior margin, and merges posteriorly into the relatively steep slope of the posterior part of the carapace. This marginal area is slightly concave, seen from the anterior or posterior ends of the carapace, and it is sufficiently conspicuous to form a characteristic feature. The marginal border is widest antero-ventrally; it is less conspicuous anteriorly, and disappears as a distinct border posteriorly. Surface smooth.

Kokomo limestone in the thin-bedded chert at the top of the old George W. Defenbaugh quarry, in Kokomo, Indiana.

This species is distinguished from *Kloedenia sussexensis*, Weller, chiefly by the position of the middle lobe, which is more remote from the dorsal margin. The steep, slightly concave marginal area along the ventral and anterior margins is an additional feature.

Illaenus depressus, *Foerste.*

An excellently preserved specimen, closely resembling figure 2 on plate 26 of volume 7 of the Geology of Ohio, occurred at the Spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky, and a similar specimen was found in the same county, northwest of Martins, in both cases in the West Union limestone. Compared with *Illaenus americanus*, Whitfield, this pygidium is broader anteriorly, more triangulate, and hence more angularly rounded posteriorly. Compared with *Illaenus triloba*, Weller, the anterolateral angles are less truncated and the depression along the border is less conspicuous and disappears before reaching the anterior margin.

Calymene clintoni, *Vanuxem.*

Plate I, Fig. 6.

Cephalon short and broad, with the width about three and a half times the length. Compared with *Calymene niagarensis*, the glabella is considerably flatter, shorter, and broader, especially posteriorly. In one specimen the width across the posterior lateral lobes is 11 mm.; across the middle pair, 7.4 mm.; across the anterior pair, 7 mm.; and across the frontal lobe the width is slightly more than 7 mm., while the length of the glabella anterior to the middle of the occipital furrow is only 7 mm. The posterior lateral lobes are large and rather triangular in form, owing to the diagonal course taken by the furrows separating these lobes from the middle pair. Along the median line of the glabella these furrows are scarcely 2 mm. apart. The other furrows are short and approximately at right angles to the median line of the glabella.

Those between the middle and anterior lateral lobes are scarcely 2 mm. in length, and those between the anterior lateral lobes and the lateral extension of the frontal lobe are scarcely more than a millimeter long. The base of the outline bordering the eye, as far as can be determined from a free cheek, is 2.2 mm. in length. No raised marginal border is present on this free cheek.

Axial lobe of the pygidium distinctly outlined by a narrow, shallow furrow; marked by seven annulations of which only the first three or four are distinct across the entire width of the lobe, while the remainder are successively more indistinct along the median parts of the lobe. Lateral lobes of the pygidium without indications of the pleuræ, moderately deflected about 2 mm. from the margin.

Geological position: Near the top of the Crab Orchard clay shales, at several localities along the road between Poplar Flats and Martin's store, also opposite the home of W. A. McEldowney, at Valley, and elsewhere in Lewis county, Ky.

Calymene niagarensis, *Hall.*

West Union bed, at the bluff northwest of Martins, also at Harin Hill, at the same horizon, in Lewis county, Kentucky.

Homolanotus delphinocephalus, *Green.*

Plate II, Figs. 19 A, B, C.

The pygidium of *Homolanotus delphinocephalus* is characterized by its acute posterior termination; by the presence of 11 to 13 axial annulations, of which the last three or four are likely to be indistinct; by seven distinct and one or two indistinct pleural segments; and by subtriangular, papulose granules. The nuchal furrow of the cephalon is very faint, and the glabella usually is rather indistinctly defined from the remainder of the cephalon, being but slightly elevated above the general convexity.

In our specimens, the cast of the inner surface of the cephalon shows a narrow and sharply defined nuchal furrow, bent slightly forward at the middle. The lateral borders of

the glabella usually are distinctly defined. The removable part of the anterior border of the cephalon not being present, its outline can not be determined.

There is no indication that the posterior part of the pygidium ever was acute. As far as may be determined from the specimens at hand, it was blunt. Two forms of pygidia appear to be at hand. The smaller specimens, attaining a length of 20 mm., have a narrower axial lobe anteriorly and both the annulations and pleural segments are better defined. Of the annulations, nine or ten are distinct, and of the pleural segments six or seven are distinct. The posterior border extends only a short distance beyond the rather distinctly defined posterior termination of the axial lobe. In the larger pygidia, attaining a width of 53 mm., both the annulations and pleural segments are less distinct, especially posteriorly. In one specimen there are seven distinct annulations, and the axial lobe merges posteriorly into the surrounding parts of the pygidium.

None of the specimens preserves any surface granules.

West Union bed, at the bluff northwest of Martins, in Lewis county, Kentucky.

An excellent pygidium of *Homolanotus*, corresponding to the larger specimens at Martins, Kentucky, was found at West Milton, Ohio, in the thin limestones which overlie the typical Dayton limestone. The width of the axial lobe anteriorly is about 23 mm. There are ten distinct and one or two indistinct annulations. There are six distinct pleural segments. The axial lobe merges posteriorly into a rather large, smooth border.

It is possible that more than one form is present among the New York representatives of this species.

Homolanotus occurs in the Waldron bed of Indiana.

Dalmanites limulurus-brevicaudatus, var. nov.

Plate II, Figs. 20 A, B, C.

Dalmanites limulurus is characterized by the slight angular prolongation of the median part of the anterior border of the

cephalon, and by the prolongation of the pygidium posteriorly into a long spine.

In our specimens, the pygidium is merely pointed and not prolonged into a spine. The axial lobe occupies seven-tenths of the length of the pygidium. It is marked by seven or eight distinct annulations. One or two additional but indistinct annulations may be present posteriorly, and at the end there is room for several more, but this part usually is smooth. There are five distinctly grooved pleural segments, one segment occasionally indistinctly grooved, with sometimes a trace of a seventh segment, not grooved. There is no broad flattened border along the sides of the pygidium. The associated cephalons do not preserve the median part of the anterior border. The condition of preservation of the specimens here described is not sufficient to determine the presence of granules, but no tubercles were noted. The length of the largest pygidium was estimated at 24 mm., with a width of 26 mm. From this the length of the complete trilobite is estimated at 67 mm.

West Union bed, at the bluff northwest of Martins, in Lewis county, Kentucky.

DESCRIPTION OF PLATE I.

Fig. 1 — *Isochilina panolensis*, Foerste. Left valve. Panola, Madison county, Kentucky. Waco limestone member of Crab Orchard formation. Magnified 4 diameters.

Fig. 2 — *Isochilina musculosa*, sp. nov. Right valve. In chert at top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 4 diameters.

Fig. 3 — *Kloedenia kokomoensis*, sp. nov. Left valve. A, anterior view, showing strong convexity of valve, and the concave elevation along the ventral border. B, left valve. In chert at the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 5 diameters.

Fig. 4 — *Beyrichia triplicata*, Foerste. Right valve. Near top of Alger clay division of the Crab Orchard formation, a mile west of Valley, in Lewis county, Kentucky. Magnified 5 diameters.

Fig. 5 — *Pentamerus divergens*, sp. nov. A, C, lateral views of pedicel valves. B, pedicel valve. D, interior of pedicel valve showing spondylium and septum. E, interior of brachial valve showing septal ridges united to the inner edges of the crural plates, and also a low median septum. The anterior margin of the crural plates is broken and the outline, therefore, is unknown. At the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 1.5 diameters.

Fig. 6 — *Calymene clintoni*, Vanuxem. Near the top of the Alger clay division of the Crab Orchard formation, along the road from Poplar Flats to Martins, in Lewis county, Kentucky. Distinct impression of glabella, anterior margin in front of glabella, and right fixed cheek; the remainder added in outline. Magnified 1.5 diameters.

Fig. 7 — *Spirifer nanus*, sp. nov. Brachial valve, cast of interior. At the spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky. West Union bed. Magnified 2 diameters.

Fig. 8 — *Spirifer exiguus*, sp. nov. A, lateral view, outline. B, pedicel valve. C, brachial valve, with top of pedicel valve. At the top of the McReynold or Interurban traction quarry, in the southwestern part of Kokomo, Indiana. Magnified 3 diameters.

Fig. 9 — *Whitfieldella erecta*, sp. nov. A, pedicel valve. B, brachial view. C, lateral view. At the top of the McReynold or Interurban traction quarry, in the southwestern part of Kokomo, Indiana.

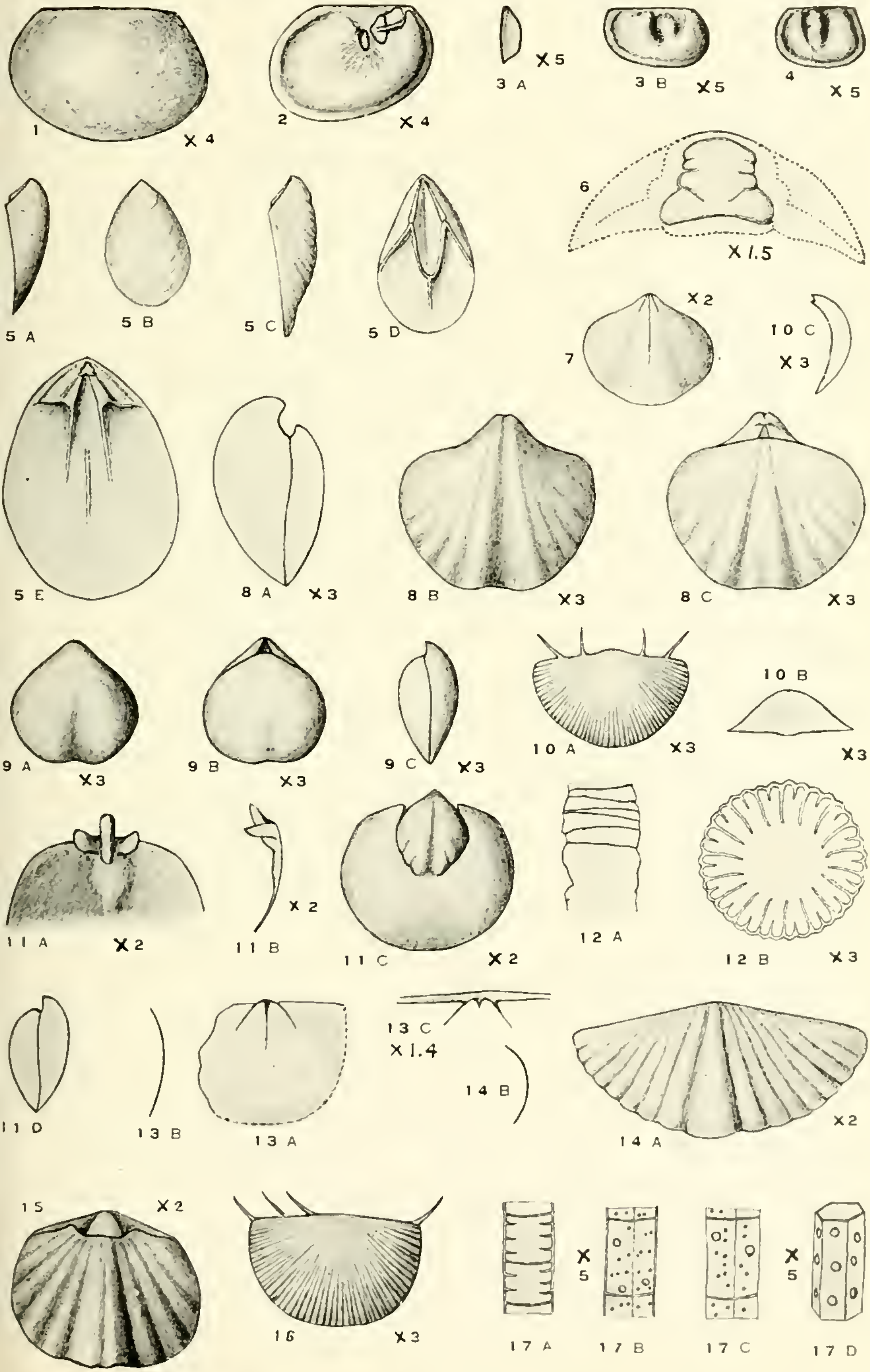
1
X 4
2
X 4
3 A
X 5
3 B
X5
4
X 5
6
X 1.5
5 A
5 B
5 C
5 D
7
X 2
10 C
X 3
5 E
8 A
X 3
8 B
X3
8 C
X 3
9 A
X3
9 B
X 3
9 C
X3
10 A
X3
10 B
X3
11 A
X 2
11 B
X 2
11 C
X 2
12 A
12 B
X 3
11 D
13 B
13 A
13 C
X 1.4
14 B
14 A
X2
15
X 2
16
X 3
17 A
X
5
17 B
17 C
X
5
17 D

Fig. 10 — *Chonetes colliculus,* sp. nov. A, pedicel valve. B, anterior view, outline, intended to show the convexity. C, vertical section. From the upper part of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 3 diameters.

Fig. 11 — *Rhipidomella magnicardinalis,* sp. nov. A, interior view of posterior half of brachial valve. B, vertical section, showing the great length of the cardinal process. C, cast of the pedicel valve. Drawings A and B are very imperfect, and serve only to show the great length of the cardinal process. At the Spring on Big Salt Lick creek, one mile south of Glen Springs, Lewis county, Kentucky. West Union bed. Magnified 2 diameters.

Fig. 12 — *Amplexus septatus,* sp. nov. A, natural vertical section. B, cross-section, magnified 3 diameters, showing primary and secondary septa. At the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana.

Fig. 13 — *Stropheodonta (Brachyprion) planus,* sp nov. A, pedicel valve, cast, showing the dental ridges and the median septal ridge. B, convexity of this valve. C, part of a ventral valve, apparently worn, with only the posterior part of the median ridge preserved. West Union bed, at West Union, Ohio.

Fig. 14 — *Spirifer repertus,* sp. nov. Brachial valve. West Union bed at Harin Hill, four miles west of Valley, in Lewis county, Kentucky. Magnified 2 diameters.

Fig. 15 — *Platystrophia pouciplicata,* sp. nov. Brachial valve, cast of interior; the impression of the cardinal process along the middle part of the cast of the cavity between the crural plates is not shown. West Union bed, at the quarry in the southeastern corner of West Union, Ohio. Magnified 2 diameters.

Fig. 16 — *Chonetes vetustus.* Foerste. Pedicel valve. Only 53 radiating striations are indicated in the drawing. In full-sized specimens the number varies from sixty to seventy. The length of the hinge spines nearest the beak is not known accurately. Near the top of the Alger clay division of the Crab Orchard formation, a mile west of Valley, in Lewis county, Kentucky. Magnified 3 diameters.

Fig. 17 — *Favosites pyriforme-kokomoensis,* var. nov. A, section of a corallite showing the tabulæ and septal spines. B, C, section showing three pores and the location of numerous septal spines. D, corallite, showing location of pores on the walls. Near the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 5 diameters.

DESCRIPTION OF PLATE II.

Fig. 1 — *Camarotoechia pisa ?* Hall and Whitfield, casts of interiors: A, brachial valve. B, lateral view. Martins, Kentucky. West Union bed. Magnified 3 diameters.

Fig. 2 — *Spirifer harinensis*, sp. nov., casts of interiors: A, brachial valve. B, pedicel valve. Harin Hill, four miles west of Valley, in Lewis county, Kentucky. Magnified 3 diameters. West Union bed.

Fig. 3 — *Camarotoechia congruens,* sp. nov. A, brachial valve. B, line indicating the convexity of the brachial valve. Between Poplar Flats and Martins, in Lewis county, Kentucky. In upper part of Alger clay division of the West Union bed. Magnified 4 diameters.

Fig. 4 — *Camarotoechia acinus-subrhomboidea,* var. nov. Pedicel valve. Martins, Lewis county, Kentucky. West Union bed. Magnified 3 diameters.

Fig. 5 — *Spirifer repertus,* sp. nov. Brachial valve. Harin Hill, four miles west of Valley, in Lewis county, Kentucky. West Union bed.

Fig. 6 — *Atrypa rugosa,* Hall. Pedicel valve. Quarry in southeastern part of West Union, Ohio, in West Union bed.

Fig. 7 — *Spirifer nanus,* sp. nov. Brachial valve. At the spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky, in the West Union bed.

Fig. 8 — *Spirifer radiatus,* Sowerby. Pedicel valve, cast of interior. Martins, Kentucky, in the West Union bed.

Fig. 9 — *Trematospira camura-pauciplicata,* var. nov. Pedicel valve. A, natural size. B, magnified 3 diameters. Quarry in southeastern part of West Union, Ohio, in West Union bed.

Fig. 10 — *Spirifer radiatus-obsoletus,* var. nov. A, brachial valve. B, lateral view. C, pedicel valve, cast of interior. At the spring on Big Salt Lick creek, a mile south of Glen Springs, in Lewis county, Kentucky. West Union bed.

Fig. 11 — *Strophcodonta (Brachyprion) planus,* sp. nov. Casts of interiors: Pedicel valves. At the spring on Big Salt Lick creek, a mile south of Glen Springs, in Lewis county, Kentucky. West Union bed.

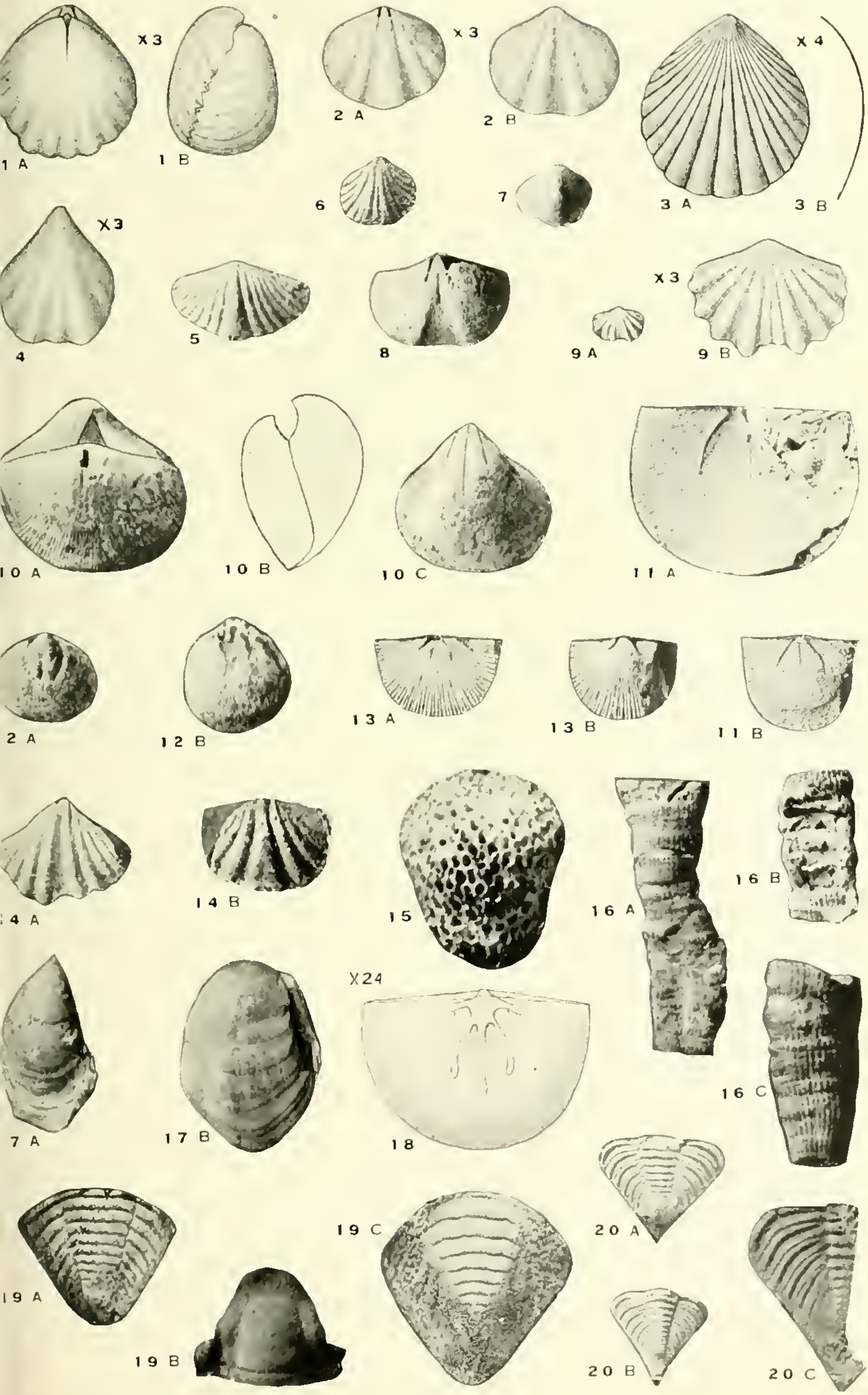
x 3
1 A
1 B
2 A
x 3
2 B
x 4
3 A
3 B
6
7
x 3
4
5
8
9 A
x 3
9 B
10 A
10 B
10 C
11 A
2 A
12 B
13 A
13 B
11 B
4 A
14 B
15
16 A
16 B
7 A
17 B
X 24
18
16 C
19 C
20 A
19 A
19 B
20 B
20 C

Fig. 12 — *Rhipidomella magnicardinalis*, sp. nov. Casts of interiors: A, pedicel valve. B, brachial valve. At the spring on Big Salt Lick creek, in Lewis county, Kentucky, in the West Union bed.

Fig. 13 — *Schuchertella conferta*, sp. nov. Casts of interiors: A, brachial valve. B, pedicel valve. Martins, Kentucky, in the West Union bed.

Fig. 14 — *Spirifer eudora*, Hall. Casts of interiors: A, pedicel valve. B, brachial valve. In the quarry in the southeastern part of West Union, Ohio, in the West Union bed.

Fig. 15 — *Favosites pyriforme-kokomoensis*, var. nov. In the upper part of the George W. Defenbaugh quarry, southeast of Kokomo, Indiana.

Fig. 16 — *Amplexus septatus*, sp. nov. Lateral views. B, weathered so as to show the tabulæ. At the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana.

Fig. 17 — *Pentamerus divergens*, sp. nov. A, pedicel valve. B, brachial valve, contorted by compression. In the upper part of the old George W. Defenbaugh quarry, in the southeastern part of Kokomo, Indiana.

Fig. 18 — *Stropheodonta mundula*, sp. nov. Interior of brachial valve. In the upper part of the Alger clay division of the Crab Orchard formation, between Poplar Flats and Martin's store, in Lewis county, Kentucky.

Fig. 19 — *Homolanotus* cf. *delphinocephalus*, Green. A, pygidium, with only the central part well preserved. B, glabella. C, pygidium, with only the central part well preserved, but the axial lobe merges posteriorly into the wide flattened border. Martins, Kentucky, in the West Union bed.

Fig. 20 — *Dalmanites limulurus-brevicaudatus*, var. nov. Pygidia Martins, Lewis county, Kentucky, in the West Union bed.

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VOL. XXI. No. 2.

THE JOURNAL

OF THE

Cincinnati Society of Natural History

... Published September, 1910 ...

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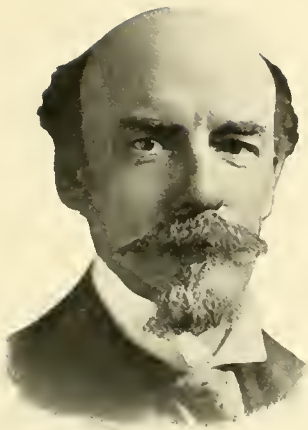

WILLIAM HUBBELL FISHER

"*Tell them all good-bye.*"

Thus did Mr. Fisher send a farewell message to his family and his friends just before he closed his eyes in death at the Bethesda Hospital Wednesday afternoon. The fatal illness that necessitated an operation had come upon him so suddenly that there was no time to summon to his bedside the wife, son and daughter, who were at the Fisher summer home in Lyon Falls, New York.

Children and birds were Mr. Fisher's ruling passions. It was his love of children that made him the Sunday School Superintendent at the Church of the Covenant for many years, and his love of birds made him the President of the Cincinnati Audubon Society. In fact, he loved all nature, and this was recognized in his election as the head of the Cincinnati Natural History Society. He was also Corresponding Secretary and a Director of the Young Men's Christian Association.

[From minutes of Executive Board of Cincinnati Society of Natural History. Called meeting.]

WILLIAM H. FISHER

Death has invaded the ranks of the Executive Board and taken from the Society of Natural History its honored President, William Hubbell Fisher, after an illness of less than three days.

He was at his office on Saturday, October 2, 1909, in the best of spirits, and for aught he knew in the best of health, having just returned from his vacation. On Sunday night he was taken suddenly ill and died at three o'clock Wednesday afternoon, October 6, 1909.

Mr. Fisher was born in Albany, New York, in November, 1843, and had all but completed his 66th year. He graduated from Hamilton College in 1864, and took his law course at Columbia College. He was admitted to the bar in the state of New York in 1867, and for the next three years practiced at Utica, that state, in partnership with John S. Crocker, an eminent patent lawyer. In 1870 he removed to Cincinnati and associated himself with his relative, Col. S. S. Fisher, at that time ex-Commissioner of Patents, and the leading patent lawyer of this city. This partnership continued until 1873, when Mr. Wm. Hubbell Fisher withdrew, and from that time until his death he had no partner in his professional work. His practice was in the law relating to patents, trade-marks and the like, and he never engaged in what is known as general practice.

He joined the Society of Natural History in 1881, and in 1895 became a Life Member of the Society. He was elected First Vice-President in 1886, and was re-elected in 1887 and 1888. In 1889 he was chosen President of the Society. In 1899 he was elected a member-at-large of the Executive Board, and was successively re-elected annually thereafter to 1906 inclusive. At the last annual election he was elected President for the second time, and was serving as such at the time of his death.

In 1887 he became a contributor to the JOURNAL of the Society, and from that time on was a frequent contributor to its pages. It is doubtful if there is anyone among its membership who was more deeply interested in the work of the Society than he. Birds and forestry he was absorbed in. He did a great deal of work along the line of photographing animals and birds in their natural environment. He frequently lectured before the Society and gave it the benefit of his scientific researches.

The conservation of forests was a favorite study with him.

In the summer and fall of 1907 he devoted a great deal of time to the preparation of the collections which were to be sent through the public schools of the city. He was Chairman of the Committee on Loan Cabinets, and to him is due the credit for whatever of success may have come from this new method of extending the usefulness of the Society's collections.

One other matter connected with the future of the Society was very near to his heart — the new fireproof museum building of the future that is to house our magnificent collections. So interested was he in this subject that he gathered at his own expense all the available literature upon museum construction — so interested a firm of local architects as to have detailed drawings made of the proposed new building, and unknown to most of his intimate friends even, paid from his own purse for an option on a tract of land on the hilltops, where it was hoped the new building would be located.

When the hands and heart of one so loyal to our Society and so instrumental in its upbuilding are stilled in death, it is becoming in his associates to pay suitable tribute to his memory.

The survivors of Mr. Wm. Hubbell Fisher in the Executive Board of the Cincinnati Society of Natural History desire to record their affection for him as a man, and their high appreciation of his labors on behalf of the Society, and request that this expression of their feeling be given a page in the Society's records.

Written by THOS. H. KELLEY.

OLIVER D. NORTON

It is somewhat difficult for one who had not the pleasure of an intimate acquaintance with him until long after he had passed the meridian of his remarkable career, to pay adequate tribute to the life and services of Doctor Oliver D. Norton. He died on Thanksgiving Day, 1907, at the advanced age of 86 years, 4 months and 28 days. All those who were his contemporaries when he was conceded a place in the front rank of the really eminent physicians and surgeons of Cincinnati preceded him to the other shore.

He was born at Westhampton, Mass., July 1, 1821, and was a lineal descendant of Thomas Norton, who came from England in 1639, and settled in Guilford, Conn. He had only the meager educational advantages of the country schools of that day.

When he was ten years of age he suffered a severe injury to his right knee, and his studies were for a time interrupted. At this early age he had developed a thirst for knowledge unusual in one of his years. The injury to his knee was looked after by Dr. J. Flint, of Northampton, Mass., the father of the renowned Dr. Austin Flint, physician and medical writer of New York. It is more than likely that the close personal contact with Dr. Flint during the many weeks while his knee was healing had a compelling influence on the mind of young Norton in the direction of the study of medicine. At the age of thirteen we find him in the office of the village doctor at Southampton compounding prescriptions and doing such other chores as were required of him, for which he received his board and lodging. He was thus enabled to attend school during the day without expense to his father.

For six years it was his good fortune to be thrown amongst teachers of rare qualities, under whose instruction he acquired a thorough knowledge of the natural sciences, particularly of chemistry and botany. During the same period he took up

the study of Latin. He also had access to an excellent private library and received much instruction and encouragement from its owner, the Rev. Vinson Gould, in his classical and scientific studies. At nineteen he taught school a part of the year, continuing his own studies during the remainder. Two years later he entered Williston's Seminary at Easthampton to prepare for college, but soon determined on the study of medicine. Instead of going to college, he entered the office of Drs. Barrett & Thompson, at Northampton, and remained with them nearly four years. While attending medical lectures he supported himself by teaching a part of the time in the Boys' High School. He was graduated from the Berkshire Medical College, at Pittsfield, Mass., in 1845. He remained in the East but one year and removed to Cincinnati in 1846. He found here, in the profession, such men as Drake, Lacke, Blackman, Shotwell and the elder Mussey, and to his credit be it said he carried forward the high standard of medical ethics which had been handed down to him by that illustrious group. It was not long before he was a conspicuous figure in the medical history of Cincinnati. The epidemic of cholera which broke out in 1849 brought him into prominence. During the Civil War, from April, 1862, until the last of May, 1865, he was under contract with the Government as Medical Officer of Cincinnati. His services entitled him to a commission, and one would have been issued to him had he consented to accept it. In the early part of his service he was placed in charge of the steamer Tycoon, fitted out under the direction of the Cincinnati Branch of the U. S. Sanitary Commission, and directed to proceed to Pittsburg Landing and other points on the Tennessee River, and receive such sick and wounded soldiers as belonged north of the Ohio River and east of Indiana, and bring them to Cincinnati. Hundreds of soldiers were thus brought here by him and cared for in the local hospital.

Early in his professional life he joined the American Medical Association, and for forty years did not miss one of its meetings.

For sixty-one years — well nigh two generations — his name appeared on the roll of Cincinnati Physicians — a record seldom equaled by anyone.

But Dr. Norton was far more than the name physician implies — eminent as he was in his profession. He was highly accomplished and possessed of much learning on various subjects. His intellectual recreations in themselves were enough to have made his a busy life, and to have stamped him as a remarkable man, if he had never devoted a day to his chosen calling. At fourteen he sang treble in the village choir, and after reaching his majority obtained a profound knowledge of music. After coming to Cincinnati, so proficient was he that he was regarded by the Catholic clergy of the city as the most eminent authority in the West on Gregorian music. In these early years, when his active mind laid hold of everything within reach, he mastered the mechanical intricacies of organ construction, and the great organ in Music Hall was built along lines and plans furnished by him. When past seventy-five years he could be found on Easter morning in the choir of St. Francis de Sales pouring forth his soul in the beautiful strains of the Resurrection.

Astronomy likewise held a share of Dr. Norton's attention, and he had great pleasure in tracing the constellations and imparting his knowledge of the heavenly bodies to any interested listener.

For one whose life was not spent in the class room, he had an exceptional knowledge of the classics, and was fond all his life of quoting passage after passage from the Greek and Latin authors which he had devoured in boyhood while ranging through the Rev. Vinson Gould's library back in Southampton.

But this many-sided man loved all nature, and was never so happy as when in close communion with her. As a boy of fifteen, when in the country doctor's office, and with his expanding intellect grasping for any knowledge within its reach, he studied botany under a master — Prof. Alvin Chapman —

and had already taken a course in practical chemistry. Anatomy and physiology came along in the course of his medical studies, and it is not to be wondered at that he was deeply engrossed in natural history. He was a diligent and discriminating collector of minerals and shells, and invariably entertained his visitor with an account of the history of some specimen he thought would interest him. The Cincinnati Society of Natural History was organized in January, 1870, and in July, 1872, Dr. Norton joined it. By turning over the pages of its records, it will be found that from 1882 until 1899, when, because of the infirmities of age, he was unable longer to attend its meetings, Dr. Norton continuously rendered some official service to this Society. So long as his health permitted he was regularly present at the monthly meetings, and rarely came that he did not bring with him a specimen for the Society's collection.

He was first elected Curator of Botany in 1882, and served two years. He was again elected to the same Curatorship to fill a vacancy in 1888. He served one year as Curator of Comparative Anatomy, three years as Curator of Osteology and three years as Curator of Anthropology. He was a member of the Executive Board for eight years, serving from 1885 to 1889, and again from 1892 to 1896. He became a life member in 1892, and in 1898 was elected President of this Society.

Up to a comparatively short time before his death, he could be seen in the spring tramping over the hills and hollows in search of plants and flowers, as full of enthusiasm as in the days of his youth. Advancing years brought no abatement of his love for investigation and search among the works of his Creator. A student from early boyhood, he carried this thirst for knowledge to the end of his days. He was a constant contributor to the collection of the Society, especially in the departments of conchology and mineralogy. It was through his good offices in 1874 that the Society was able to purchase from the owner the splendid specimen of *Bison latifrons,* which has adorned its walls ever since.

The Society will long continue to be a debtor to Dr. Norton for the enthusiastic devotion and warm personal interest which he took in everything that pertained to its welfare.

While he lived, all willingly yielded the first place to him in the Society's councils. Now, that he has passed from us, we desire to place on record this meager and imperfect tribute to his memory.

PROCEEDINGS

Cincinnati, O., April 5, 1910.

The annual meeting of the Cincinnati Society of Natural History was called to order at 8.30 o'clock.

Vice-President M. H. Fletcher in the chair.

The Secretary read the minutes of the last annual meeting, which were approved.

Mr. Kelley read the report of the Committee on School Loan Cabinets. An interesting report, showing the number of school children who had used these cabinets. The report was filed.

The appointment of an Auditing Committee was referred to the new President, Dr. Arch I. Carson.

Mr. T. H. Kelley, for the Trustees, made a report, in which he stated that there had been no change in the investments of the Society's funds during the year, a statement of which investments he gave. The report was ordered filed.

The report of the Museum Director was then read by Mr. T. B. Collier, showing an excellent condition of the Museum and property of the Society at a minimum expense. On motion the report was ordered filed.

The printing of a popular memorial number of the Journal was brought up and discussed, and it was the opinion of those present that it would be desirable to publish such a number. Prof. M. F. Guyer reported that at some European societies recently visited by him, inquiries had been made as to why the

JOURNAL was not more regularly issued. On motion of the Secretary the Treasurer was instructed to pay the excess of cost of the memorial number over what had been raised by subscription.

At a meeting of the Executive Board, held April 5, 1910, the Secretary brought up the matter of printing another JOURNAL and making it a memorial number to William Hubbell Fisher. This was discussed, and it was the opinion of all those present that such a number should be printed. The following offered to subscribe the amounts as follows toward defraying the cost of the same:

Chas. Dury, $5.00; Thos. H. Kelley, $5.00; T. B. Collier, $10.00; Dr. M. H. Fletcher, $10.00; Prof. M. H. Guyer, $5.00; Dr. A. J. Woodward, $5.00; Dr. H. A. Smith, $5.00. Total, $45.00.

There being no other business, on motion the Chair appointed a committee to nominate officers for the coming year, who reported the following nominations:

President, Dr. Arch I. Carson; First Vice-President, Dr. M. H. Fletcher; Second Vice-President, Prof. George W. Harper; Treasurer, T. B. Collier; Secretary, Charles Dury. Members-at-large of the Executive Board, Thos. H. Kelley, Herman Wuestner and E. J. Carpenter. Trustee for two years, Thos. H. Kelley.

There being no other nominations, the Secretary was instructed to cast the ballot of the Society for the nominees, and they were declared elected.

Adjournment at 9.45 P. M.

CHAS. DURY, *Secretary.*

THE PASSENGER PIGEON

ECTOPISTES MIGRATORIUS, *Linn*

A Reminiscence

BY CHAS. DURY

As late as the 60's and early 70's the Wild Pigeons came to southern Ohio in vast flocks. Their fall migrations were a wonderful and impressive sight. These great flights most frequently took place in October, although I have observed them to begin in late September, and continue at intervals into November. The usual time for the flight over Cincinnati and vicinity was in the afternoon and evening, and generally when the day was cloudy. The birds flew in long columns or strings, side by side. They first appeared in the northwest, flying towards and disappearing in the southeast. At times several of these flocks would be in sight at one time, and they were so long from end to end that they reached almost from horizon to horizon. During the day they flew very high, out of the range of shotguns. The present site of the Zoological Garden was then a series of ridges, covered with scattered beech trees, huge old ones, with dead tops. During the flight of the pigeons I have stood on one of these ridges and fired at pigeons as fast as I could reload my muzzle-loading gun, generally with scanty results, until dusk in the evening, when some of the birds would descend and alight on the dead branches of the tree tops, probably with the intention of resting for the night. At such times a few birds were secured, but the number killed in that way was trifling when compared to the wholesale slaughter and exterminating methods of the professional pigeon trappers. The birds did not come over in the spring in any such numbers as they did in their autumn flight, and probably returned by a different route. At times in the spring, generally April, large flocks appeared in different patches of forest in this vicinity, where they remained for some days. It was in seasons when the beechnuts were abundant on the ground, and they fed on these nuts as long as any of them

lasted. When the birds were shot at, they would fly from one end of the woods to the other, and many of them were killed.

For several years in succession a great flock came to the Blatchley woods in the north end of Avondale (now called Rose Hill), where I have bagged as many as I could carry. This was always in April and early May. By late May they were gone. Their method of feeding in the beech woods was very interesting and peculiar. I have seen a large flock fly down onto the ground to glean for beechnuts, those in the rear continually flying over those ahead, so that the mass looked at a distance as though they were rolling over the ground.

All mast, such as beechnuts and acorns, were picked up, none in sight escaped, and were swallowed whole. I have often been surprised at the large acorns these birds were able to swallow. The bill and throat were very elastic and could be widely stretched. I have shot birds that had the crop so distended with these nuts as to be nearly as large as an orange, and I have taken the nuts out, washed and eaten them.

When the birds were intent on feeding was a favorable time to slip up within shotgun range, which could be done by hiding behind a tree trunk, but if one bird took alarm and flew up, the entire flock was sure to follow.

Some of the birds nested in the great woods (growing at that time) west of Mill Creek, opposite to what is now Elmwood Place. I have shot squabs two-thirds grown that had been hatched there, as late as the year 1875. The pigeons that nested in these woods were not numerous and much scattered over the woods. They usually made their nests high up in the tallest trees.

As a food bird the old ones were not very good, being rather dry and tough, though well flavored, but the younger ones were excellent.

In this woods (then called Este's Woods) I have shot young pigeons in September, nearly one-half grown, that had

been feeding on "poke berries" (*Phytolacca decandra*) so that all the fluids of the body were stained with the bright-colored juice of these berries.

The size of the birds and the lateness of the season led me to the conclusion that they were of a second brood and that they were double brooded.

I was acquainted with a couple of men named Cone and Barr, who made a business of trapping wild pigeons. They followed the birds over the country, netting them for the market. To decoy them down to the nets, they used "stool pigeons." These were wild birds which they kept for the purpose in cages. They were made blind temporarily by stitching up their eyelids with a loop of thread. When a flock of birds were seen approaching, the blinded ones were thrown up in the air in front of the nets, and the birds, not being able to see, fluttered down, generally decoying and bringing the flock to the ground. The stool birds could not escape, as a string was attached to the leg. Other decoy birds were enclosed in net coops placed so the approaching birds could see and hear them. These men assured me that if they got any at all, they generally secured the entire flock. This was in the spring, near the roosting and breeding grounds.

The captured birds were killed by having the neck pinched and dislocated. They were shipped all over the country in barrels if dead, or in crates if shipped alive. A shooting club that shot at the trap in the old Queen City Trotting Park, used them for targets. Whole crates were used in this way, and most of them were mangled with shot as they rose from the trap into the air.

The traps used at that time were made of a long, slender piece of hickory for a spring, on the end of which was nailed a box with a hinged lid. When the spring was bent down the lid was held shut; when the spring was liberated, it flew up with great force, throwing the imprisoned bird into the air,

In this connection, I have noticed that the wild pigeon, when thrown into the air, quickly righted itself and made a bee line

for the woods; but the domestic bird, when liberated under similar circumstances, made for the nearest building.

Those birds that were fortunate enough to escape at the trap, had to run the gauntlet of boys and others who shot them when they flew out of bounds, so that few escaped. The wild pigeon was a much more difficult bird to shoot on the wing than the domestic one.

I have seen the birds sell, when in danger of spoiling, as low as 25 cents per dozen in Cincinnati market, but 50 cents to $1.00 per dozen was the usual price. All kinds of game was plenty and cheap in those days. Wild ducks and geese were so abundant at times that they were a drug on the market, and could be bought very cheaply.

Cone & Barr, the pigeon trappers, when in Cincinnati, made headquarters at J. B. Owing's game store, which at that time was on the south side of Fifth Street, opposite where the Government Building now stands.

When the Zoological Garden opened, in 1875, they had a fine bunch of wild pigeons — about 22 birds. Gradually these have died, one by one, until now but two veritable patriarchs remain. At first a few were reared in the garden, but as the birds became older, though they made nests and laid a few eggs, none were hatched, as the eggs were no longer fertile. During the last twenty years I have heard rumors of the return of the wild pigeons, but whenever I have investigated these stories, have found them without foundation, generally referring to another bird. A few scattered bunches may yet be alive. I hope it is so. About eight specimens are all I have preserved, for at that time of abundance I did not think it possible that such a vast myriad could have been exterminated during my lifetime. The eight that were saved are: three in my own collection, three in the Cuvier Club's, and two at the Museum of the Cincinnati Society of Natural History. Color, form and habits considered, the Passenger Pigeon was the most remarkable of the pigeon tribe. The Audubon plate of this exquisite bird is exceedingly beautiful and lifelike. The

unspeakable cruelty of the method by which these birds were so ruthlessly butchered, is a blot on the fair page of ornithological history in this country. The parent birds were trapped at their nesting places while brooding their young, leaving the helpless babies that had escaped the butchers to suffer a slow death by starvation.

Those who would read more in detail of how the wild pigeons were destroyed, are referred to a book by W. B. Mershon, entitled "The Passenger Pigeon" (Outing Publishing Co., 1907).

One foggy day in October, 1884, at 5 A. M., I looked out of my bedroom window, and as I looked six wild pigeons flew down and perched on the dead branches of a tall poplar tree that stood about one hundred feet away. As I gazed at them in delight, feeling as though old friends had come back, they quickly darted away and disappeared in the fog, the last I ever saw of any of these birds in this vicinity.

ECOLOGICAL NOTES ON BIRDS

By Chas. Dury

Bachman's Sparrow

Peucæa æstivalis bachmani, *Aud.*

During the spring and summer of 1907 and 1908 this species has become increasingly common in certain localities at Cincinnati. I have observed it at Avondale, Hyde Park, Madisonville, Home City, etc. The first one identified here was by Miss Laura Gano, April 27, 1897. From 1865 to 1890 I devoted much time to the study and collection of local birds, and secured specimens of all the species obtainable here, and *P. bachmani* was not among them. Nor was it identified by Dr. Langdon, who has omitted it from his list of Cincinnati birds published in the Journal, January, 1879. October 14, 1809, one of this species came within a few feet of my window and was picking the seeds from a head of coarse grass. It was quickly spied by a bunch of "sparrows" (*Passer domesticus*) who attacked it and drove it away.

Note on the Duck Hawk

Falco peregrinus

The Custodian of the City Hall in Cincinnati had a flock of domestic pigeons that lived in the tower of the Hall. He observed a hawk take a pigeon and fly with it over Eighth Street to the cross on top of the high spire of the cathedral opposite, where it alighted, tore the bird to pieces and devoured it. Each day at about the same time the hawk came for his meal. It was finally shot by one of the police and proved to be a duck hawk, a rare bird in southwestern Ohio. I have only three specimens, all from Mercer County, Ohio, taken many years ago. And there is one in the Cuvier Club's collection, taken near Milford, in Hamilton County, Ohio.

Note on Cooper's Hawk

ACCIPITER COOPERI

A female of this hawk, while in pursuit of a wood thrush, flew against a large plate-glass window in Avondale with such terrific force that both the thrush and the hawk were instantly killed. The reflection of trees and shrubbery opposite the window caused the illusion of an open space with trees beyond, that deceived both birds, and the thrush, hoping to escape, was dashed to death, as was also the hawk. This window has proved a death trap for birds, others having been destroyed in this way. The stomach of the hawk was entirely empty. It was in beautiful plumage and has been preserved.

Bald Eagles

HALLETUS LEUCOCEPHALUS

October 22, 1907, six of these birds were observed sailing over Cincinnati (Avondale) high up in the air. They kept together and sailed in small circles, drifting slowly from the northwest to southeast, where they disappeared from view. Two had the heads and tails white, the others were in the dark plumage.

How Weeds are Introduced by Birds

A vacant lot next to my home had the soil taken off, leaving only the subsoil exposed. Not a bit of vegetation was left and the surface was bare. In five years this lot was a dense jungle of weeds, the most conspicuous being sweet-scented clover (*Melilotus alba*) and Canada thistle (*Cirsium arvense*), though I recognized many other noxious weeds and coarse, worthless grasses — how did they come there? The abutting lots were covered with clean bluegrass sod. They were conveyed by birds, and must have been carried some distance. Several species of sparrows were observed to frequent the place. The tenacity with which these tough and hardy weeds maintain their existence is very remarkable, and I found it difficult to eradicate them. Doubtless the place was reseeded

each year by the birds, who came in numbers to feed on seeds which they, themselves, had planted.

In cleaning out a gutter on the top of a two-story house (3217 Reading Road), I found it filled with leaves fallen from an overhanging tree. These leaves, combined with soot and sparrow (*Passer domesticus*) droppings, had formed a soil, on which there was a thick growth of weeds. The seeds for this growth had been conveyed there by the sparrows, as they could not have reached there in any other way. In computing the value of birds as destroyers of weed seeds, due credit should be given them as distributors of these same seeds. This is an explanation of the methods by which pernicious weeds and grasses are scattered and distributed in lands where they never occurred before.

Early Birds. Cincinnati, Ohio

From June 14 to 24, 1908, some observations were made to ascertain which species of birds were earliest astir and singing. June 14th, robins begin to sing at 3.40 A. M. (cloudy), followed a few minutes later by the wood thrush. Thirty minutes later the sparrow (*Passer domesticus*) began its monotonous, unmusical chatter. June 24th robins begin to sing at 3.30 A. M. (day clear). At this time the birds were rearing a second brood. Robins were breeding in abundance here in 1909, and in markedly decreased numbers in the spring of 1910. Reports from Tennessee state that robins have been killed for food in enormous numbers in that state during the winter of 1909-10. This may account for their scarcity here. The laws of Tennessee allow robins to be killed from October to April 15th, as game. The efforts of those bird lovers in Ohio who encourage these valuable songsters to breed and multiply is nullified when the birds in their migrations visit this state and are killed. The value of a robin as a food bird is very slight, while their value as a song and insectivorous bird is very great, and it is a very bad economic policy that allows them to be killed.

The Mulberry

MORUS RUBRA, *L.*

The old mulberry tree that stood in the corner of the woods, alongside of the ancient rail fence, was a favorite feeding place for many creatures that lived in the woods. Early in the morning came the graceful and active gray squirrels running along the rails of the fence to the tree, each one eager to make its breakfast on the luscious fruit, so intent on getting it that they frequently exposed themselves in a most reckless manner to the gunner, often with fatal results. Many nice, young squirrels have I secured by laying in wait within easy shot range of the old tree. These young squirrels were the most delicious morsels when broiled or fried. The old ones were tough and more rank of flavor. A host of birds, such as jays, catbirds, robins, grackles, thrushes, red-headed woodpeckers and other fruit-eating species, also made frequent visits to the tree, and fairly reveled in the sweet, juicy fruit, always returning at intervals during the day to eat until satisfied. At night another group of creatures — raccoons, opossums, skunks, woodchucks and various mice came to share the treat old Mother Nature had so bountifully provided. The surplus decaying fruit that dropped to the ground furnished food for a myriad of insects — bees, wasps, flies and beetles — who were there as long as a vestige of fruit remained. With what unerring certainty these varied creatures know when the fruit is ripe! It was rare that the mulberry tree failed to produce an abundant crop, and in seasons when other fruits were killed by late frosts, the hardy mulberry withstood their destructive influences and produced its crop as usual. An examination of the droppings of these creatures show how completely their food consists of mulberries at this season of the year — almost to the exclusion of everything else — and it also shows how the seeds are scattered through the woods, and accounts for the numerous mulberry trees springing up in all suitable places.

ECOLOGICAL NOTES ON INSECTS

By Chas. Dury

During forty years collecting insects near Cincinnati, Ohio, some interesting facts in geographical distribution have been met with. Species belonging to the fauna of the South have been taken, mingling with those regarded as northern in their range. One that has escaped capture in all these years is *Nanosella fungi,* a beetle belonging to the *Trichopterygidæ.* Described in 1868 from Mobile, Alabama, it has remained very rare. It is perhaps the most minute beetle known, being less than 1-3 mm. in length. July 18 to 23, 1907, I took seventy-five on a small patch of *Polyporus* fungus, that was growing on a beech log.

Morio monilicornis, *Lat.*

Seven specimens of this graceful Carabid beetle were taken April 19, 1908. They live under the bark of dead trees. They are abundant in Florida and Lower California. I was surprised to find them so far north.

Loxandrus rectus, *Say.*

Thirty-six specimens of a *Loxandrus* that comes nearest *rectus* were taken in a damp, shady ravine or creek bed. They were hiding under flat stones. May 19 to August 21, 1909, they were very abundant. I have always found *Loxandrus* rare before. This is an illustration of the fact that the so-called rare species may be common enough if one can only find their habitat at the proper time.

Pentagonica flavipes, *Lec.*

This pretty little Carabid was taken abundantly November 3 to 10, 1909, in company with a few *Cyparium flavipes,* Lec. *Pentagonica* has never been taken here before, and but one of *Cyparium.* They were sifted from the debris under fungus.

Meromacrus acutus, *Fab.*

September 1, 1909, I captured here a male of this pretty *Syphid* fly, which I have taken before at Brownsville, Texas. The family of flies to which this species belongs (*Syrphidae*) are numerous here. Many of them are beautifully colored, mimicing in a remarkable manner some of the stinging insects, such as bees and wasps. None of them are at all dangerous to handle nor injurious in any way, and some species are vastly beneficial to agriculture, feeding in the larval stages on plant lice. An excellent monograph of the family has been published by Williston, Bulletin No. 31, U. S. National Museum. In the recent catalogue of N. A. Diptera, Smithsonian miscellaneous collections, Vol. XLVI, Page 390, this species is given with a southern range.

Calephelis borealis, *G. & R.*

This little butterfly was flying in abundance July 18th, at Terrace Park, Cincinnati, Ohio. It has been taken in Central Ohio by Prof. Hine and at College Hill, Cincinnati, Ohio, by Miss Annette Braun. Dr. Holland, in Butterfly Book, Page 233, gives it as a rare species. It seems to be common in Ohio, though local in distribution.

The Tussock Moth

Notolophus leucostigma, *S. & A.*

July 16, 1908, the tufted caterpillars of this moth were in such numbers on a Carolina poplar tree in front of my house in Avondale, that the foliage was almost eaten up. On the above date they were mature, crawling down out of the tree and making their cocoons on the sides of my porch and house, and in crevices of the bark of the tree. Their hairs and spines caused considerable irritation when they touched the human skin. None of the birds which frequented the tree were observed to eat any of them. I feared a renewed visitation of the pests the next year, but so completely were they parasitized that none appeared, and up to the fall of 1909 there were none

It was a striking illustration of the method by which nature checks the undue multiplication of a species. As the host becomes more abundant, the parasites having plenty of material on which to feed, also reach maximum numbers, and the host is nearly all destroyed. This accounts for the so-called waves of abundance of many destructive species.

A Beetle New to Cincinnati

A new building in Covington, Ky., became suddenly overrun with insects, pronounced by the health officer to be "Sand Fleas," which he said were breeding in a pile of sawdust that was stored in a stable in the rear. August 26th I examined the premises and found the supposed "Sand Fleas" were beetles belonging to the family *Latridiidæ, Cartodere argus,* a species not heretofore recorded from Cincinnati. I secured thirty-six specimens, all taken in the bath tub. Several days previous to this, hundreds were crawling over the walls and beds. The family, who imagined themselves "all bitten up" with this harmless little creature, went away for five days and had sixty-five pounds of sulphur burned in their apartments (to the great damage of interior decorations) in an effort to destroy the insects, but without avail. I found they were not coming from the sawdust (which was of oak), nor could I find any evidence of their breeding on the premises. But, in the stock of a nearby drug store I found every package of herbs and roots riddled with various beetles, mostly *Sitodrepa panicea,* the drug beetle. In a package of "Solomon's Seal" (*Polygonatum biflorum Ell*) I found this *Cartodere* breeding. Some packages of "Witch Hazel" (*Hamamelis*) were a curious sight. The outer envelope of paper was riddled with round holes of two sizes, through which the beetles had emerged, and the leaves within were eaten up. If those who store such vegetable products would keep them in tight boxes, and evaporate some bisulph. carbon occasionally to disinfect them, this damage to the stock could be averted and unnecessary alarm caused by a perfectly harmless species prevented.

NEW SPECIES AND ADDITIONS TO THE LIST OF CINCINNATI COLEOPTERA

By Chas. Dury

Family Pselaphidae

Batrisodes caseyi, sp. nov.

Color, bright rufous. Pubescence not dense, recurved and rather coarse. Length, 3mm. Head as wide as long. Eyes small, but very prominent. Occiput, high and rounded, descending to the frontal and lateral margins, from which it is separated by a shallow sulcus, crescentic in shape. Last palpal joint is oval, bluntly pointed, more rounded on outer side and three times as long as thick. Antenna stout, less than one-half as long as body. Eleven-jointed: 1st joint thick, larger than wide; 2d, 3d, 4th, 5th and 6th joints subequal transverse and almost as wide as the first joint; 7th and 8th joints small and transverse; 9th and 10th joints larger, strongly transverse and subequal in size; 11th, with base rounded and apex pointed, as long as the 8th, 9th and 10th together. Prothorax slightly longer than wide, widest in front of middle. Base squarely truncate, with sharp angles, and trifoveate, with canal connecting the foveae. A deep, median groove running from middle fovea almost to apical margin. Elytra about twice as wide as thorax, with suture beaded and minutely, sparsely punctate. Legs rather thick, with femurs strongly clavate. The anterior pair angulate on lower edge. Hind tibiae compressed and curved; claws, two, unequal. Three specimens from Cincinnati, Ohio, and one from Indiana (Prof. Blatchley). The very small 7th and 8th joints of the antennæ of male is a character that readily separates this species from any described form that I know of. Dedicated to Thos. L. Casey, of Washington, D. C., who has done so much to make known the curious little organisms belonging to the family *Pselaphidae.*

Family Staphylinidae

Hoplandria acudentata, sp. nov.

Color, brown with pale markings. Legs and four basal joints of antennæ paler. Body above very shiny. Head, pronotum and elytra finely punctured. Abdomen impunctate above, finely punctured beneath. Thorax transverse, sides arcuate, hind angles broadly rounded. Apex truncate, with front angles less rounded. Elytra conjointly wider than long, arcuate on the sides. At the posterior sutural angles are two acute teeth pointing upwards. Abdomen very depressed above, rounded on sides. The first four segments with double carinac laterally. The second segment has a large crescentic elevated tubercle or ridge, and the last segment a sharp, flattened triangular tooth. Pubescence fine and inconspicuous. Length, 4 mm.; width, 1.2 mm. One male taken in fungus belonging to the *Agaricinæ,* November 3, 1909, Cincinnati, Ohio. Two females were taken at same place, that may be of this species. They are a trifle smaller and lack the tubercles and ridge, which are evidently secondary sexual characters of the male. This is one of the most remarkable *Aleocharids* I have seen, in the ridge and tooth of abdominal segments, teeth of elytra and very shining integuments.

ADDITIONS TO CINCINNATI COLEOPTERA

Since the publication of the list of additional species, this Journal, Vol. XX, No. 7, the 116 species enumerated below have been taken and identified, and are now in my collection, where they may be examined. These, added to those heretofore listed, make a total of 2,356 species so far identified from here.

Carabidæ
- Schizogenius planulatus Lec.
- Bembidium postremum Say.
- Loxandrus sp. near rectus.
- Platynus cupripennis Say.
- Lebia furcata Lec.
- Pentagonica flavipes Lec.
- Morio monilicornis Lat.

Hydrophylidæ
- Cercyon unipunctatum Linn.

Silphidæ
- Cholera luridipennis Mann.
- Colon magnicolle Mann.
- " dentatum Lec.

Scydmaenidæ
- Connophron formale Csy.
- " fulvum Lec.
- Eumicrus longicollis Csy.
- Ascydmus tener Csy.
- Pycnophus rasus Lec.

Pselaphidæ
- Batrisodes caseyi Dury.
- " temporalis Csy.
- Tychus longipalpus Lec.
- Anchylathron cornutum Brend
- Euplectus duryi Csy.
- Leptoplectus filiformis Csy.
- " exillisimus Csy.

Staphylinidæ
- Hoplandria acudentata Dury.
- Falagria dissecta Er.
- Philotermes pennsylvanica Kr.
- Philonthus sericinus Horn.
- " umbrinus Grav.
- Uliusa cribratula Csy.
- " pusio Csy.
- Euaesthetus americanus Er.
- Scopaeus exiguus Er.
- " versicolor Csy.

Staphylinidæ
- Pseudolathra analis Lec.
- Gyrohypnus micans Csy.
- " vernicatus Csy.
- Bryoporus rufescens Lec.
- Oxytelus suspectus Csy.
- Arpedium schwarzii Fv.
- Anacyptus sp. (new?).
- Actobius parcus Horn.
- Meronera venustula Er.

Trichopterygidæ
- Nanosella fungi Lec.
- Ptinella pini Lec.
- " quercus Lec.
- " sp.?
- Nephanes laeviusculus Matth.

Coccinellidæ
- Scymnus terminatus Say.
- " flavifrons Melsh.
- " rubricauda. Csy.

Endomychidæ
- Mycetina testacea Ziegl.

Cryptophagidæ
- Ephistemis apicalis Lec.
- Atomaria pusilla Schoen.

Mycetophagidæ
- Mycetophagus bipustulatus Melsh.

Dermestidæ
- Dearthrus longulus Lec.
- Cryptorhopalum haemorrhoidale Lec.

Histeridæ
- Hister interruptus Beauv.
- " curtatus Lec.
- " cognatus Lec.
- Bacanius tantillus Lec.
- Acritus discus Lec.
- Aeletes simplex Lec.

NITIDULIDÆ
Epuraea truncatella Mann.

LATHRIDIIDÆ
Cartodera argus Reitt.

TROGOSITIDÆ
Nemosoma parallelum Mels.

DASCYLLIDÆ
Cyphon collaris Gúer.

ELATERIDÆ
Elater manipularis Cand.
Melanotus glandicolor Melsh.
" trapezoideus Lec.
" cribulosus Lec.
" ignobilis Melsh.
" cuneatus Lec.
Limonius basilaris Say.
Corymbites heiroglyphicus Say.

BUPRESTIDÆ
Agrilus ferrisi Dury.
" putillus Say.
" masculinus Horn.
" defectus Lec.

LAMPYRIDÆ
Celetes basilis Lec.
Eros trilineatus Melsh.
Cænia dimidiata Fab.
Pyropyga minuta Lec.
Photinus consanguineus Lec.
Telephorus divisus Lec.
Polemius laticornis Say.

CLERIDÆ
Cregya vetusta Spin.

PTINIDÆ
Cænocara tenuipalpa Fall.
Dinoderus porcatus Lec.

CIOIDÆ
Xestocis levettei Csy.
" miles Csy.
" insolens Csy.
Brachycis brevicollis Csy
Octotemnus lævis Csy.

SCARABÆIDÆ
Atænius cognatus Lec.
Dichelonycha diluta Fall.
Cremstochilus canaliculatus Kby.
" castaneæ Knoch.
" retractus Lec.

CERAMBYCIDÆ
Goes pulverulentus Hald.
Leptura subhamata Rand.
Saperda discoidea Fab.

CHRYSOMELIDÆ
Donacia cincticornis Newm.
Graphops pubescens Mels.
Tymnes varians Lec.
" metasternalis Cr.

TENEBRIONIDÆ
Helops sulcipennis Lec.
Palorus subdepressus Woll.

MELANDRYIDÆ
Abstrulia variegata Csy.

MORDELLIDÆ
Mordellistena delicatula Dury.
" ruficeps Lec.

ANTHICIDÆ
Elonus princeps Csy.
Zonantes subfasciatus Lec.
Anthicus lutulentus Csy.
" melancholicus Laf.

CURCULIONIDÆ
Apion impunctistriatum Smith.
Otidocephalus scrobicollis Boh.
Listronotus sordidus Gyll.
Anthonomus sycophanta Melsh.

YOUNG SNAKES TAKING REFUGE IN THE MOTHER'S MOUTH IN TIME OF DANGER

Some Additional Facts

By Chas. Dury

In referring to some recent works on Herpetology, I find very doubting, scant, or no mention at all of this remarkable habit. But little is known of the life history of this badly abused and misunderstood class of reptiles. But few of our snakes are venomous, and these practically extinct in southern Ohio. On the other hand, the harmless species are becoming scarcer each year. Many of these species have a distinct economic value, because of the nature of the food they eat. This has been brought to my notice in an examination of the contents of stomachs of some of the smaller species. In one red-bellied garter snake (*Storcria occipitomaculata*) I found "cut-worms" (*Larvae of agrotis*) in the alimentary tract, reaching from neck to vent, and in others various injurious insects, while some of the larger forms destroy numbers of mice. I saw a farmer in Bracken Co., Ky., crushing the body of a garter snake a foot long, with a rock. I said to him, "you are killing one of your best friends." He replied with a quotation from Scripture in justification of his cruelty and ignorance. That mother love and solicitude for her offspring is well developed in these reptiles the following incidents bearing on the above habits will show:

Some years ago W. H. R. Markley, of Kentucky, related to me the following incident:

"I was traveling through Kentucky and stopped over night at Mt. Sterling. I was up early next morning taking a stroll through the town. I came to a store window in which there was a large rattlesnake on exhibition. The snake was a female and had several small young ones laying on the floor of window near her head. I rapped sharply on the glass with my cane and the old snake widely opened her mouth and the young ones

rushed into it and disappeared down her throat." I have found Mr. Markley a good observer and perfectly reliable. The second case that has come to my knowledge was as follows:

While walking through the mountains of northern Georgia last June (1909), on a collecting trip, I stopped at Osborn P. O. to talk to Mr. Foster, a very intelligent mountaineer. He told me his neighbor had recently surprised two female rattlesnakes as they lay among some rocks. Each snake had her young with her. The young ones of one snake were smaller than those of the other. When he surprised them, both old snakes opened their mouths and the young ones rushed in, the larger ones going into one and the smaller ones into the other. Both old snakes, and also the young, were killed, and from the description were *Crotalus horridus*, Linn., that being the most common species in those mountains. Unfortunately they were not saved. Mr. Foster's son cut out of one rattlesnake fifteen young of different sizes. He says the young ones go clear down the throat. The parent snake leaves them to shift for themselves when they attain a length of from 8 to 12 inches. The union of the sexes takes place, he says, about July 1st, and the average size in these mountains of the adults is from 3½ to 4 feet in length. Mr. Sol. Stephan, Superintendent of the Cincinnati Zoo, has kindly given me the following incidents:

"I once called to see a man who had some rattlesnakes in a glass case. One of them was an old female with young ones about 8 inches long. When the snakes were startled the old female opened her mouth and two of the young ones ran into it. The owner assured me that when the young ones were smaller, they always, on being alarmed, went down their mother's throat."

The other case mentioned by Mr. Stephan was an old female garter snake that had a bunch of young ones inside of her. These were shaken out in a lively condition.

In Cope's Crocodilians, Lizards and Snakes of North America, Page 1,148, Prof. O. P. Hay gives an instance in

Indiana of two female prairie rattlers (*Sistrurus catenatus*) in which the young passed freely in and out of the mother's mouth until they were a month old.

The late Dr. G. B. Goode, of Washington, D. C., has published a paper in Forest and Stream, October, 1873, page 118, entitled, "Do Snakes Swallow Their Young?" and a year later he published a very interesting note in the Proceedings of American Association for the Advancement of Science, Vol. XXII, pages 176-185, 1874. As both of these papers are out of print, it might be of interest to refer briefly to some of the facts relating to this habit. As early as the 16th century Spencer alludes to it in the "Faerie Queene." Dr. Brown, in his vulgar errors (1646), says, "The young ones will, upon any fright, for protection, run into the belly of the dam. For then the old one receives them at the mouth, which way, the fright being past, they will return again."

In 1802, M. Palisot de Beauvois, an eminent French naturalist, gives some very important observations on the rattlesnake. He says, "When making my first excursion into the Cherokee country, I happened, while botanizing, to see a rattlesnake in my path. I approached it as softly as possible. But just as I was about to strike, imagine my surprise to see it, after sounding its rattle, open a very large mouth and receive into it five little serpents, each about as large as a goose quill. Astonished at this spectacle, I retired some distance and hid behind a tree. After some minutes the animal, believing itself out of danger, again opened her mouth and allowed the little ones to escape. I again advanced and the little ones retreated to their stronghold, and the mother, carrying her precious treasures, disappeared among the underbrush, where I was not able to find her."

As Dr. Goode justly remarks, the character and reliability of Beauvois ought to have settled the question long ago. Dr. Goode published a short note in American Agriculturist, February, 1873, asking for information on the subject from those whose occupation brought them in contact with these reptiles. He received many replies from this and other sources. The

total number of testimonies was 120. Some of these cases were as follows:

Herman Strecker, the entomologist of Reading, Pa., mentions two cases of the garter snakes where the young took refuge in the parents' belly. In one case he says, "I caught one of these snakes that seemed to be of immense size. I took it home and placed it in a cage, and on going to look at her some time after, I discovered that about thirty young ones had emerged, and while I was looking, two more crept out of her mouth and finally a third one did likewise."

C. F. Brackett, of Princeton, gives the following:

"A workman, mowing on my father's hay field, cleft off a thick mass of moss and sphagnum, revealing about a dozen snake's eggs. Some of these were torn open and out of them came perfectly formed 'milk adders.' Soon the old snake appeared, and, putting her mouth down to the ground, all that had been liberated from the eggs voluntarily and hastily went into the mother's mouth." As usual, the mother was killed and the young were found in her belly still active. This habit does not seem to be confined to the snakes, for Mr. Newman, in Zoologist, page 2,269, gives a note concerning the "scaley lizard" (*Zootoca vivipara*), where one of this species was found with two young ones. She was brought home in a vasculum, and when this was opened the young had disappeared and the mother's belly was greatly distended. It was supposed she had eaten her young, but the next morning the young reappeared and the mother was as lean as at first.

Dr. Goode, in summing up, says sixty-seven witnesses saw the young snakes enter the parent's mouth. Twenty-two of these heard the old snake make a whistle, hiss, click or sound of her rattles to warn the young ones there was danger. Five persons were considerate enough to wait and see the young reappear when the danger seemed over. One saw this repeated several days. Three saw the young snakes coming out of the mouth and, not having seen them enter, were naturally much astonished. Five struck the parent snake and saw the young

rush from her mouth. Eighteen saw the young shaken out by dogs or run from the parent's mouth. Thirty-three persons who did not see the young enter the parent, found them living within her body. Only twenty allowed the persecuted mother to escape. For it should be remembered that in Dr. Goode's mass of evidence the majority of cases refer to non-venomous, harmless and useful species, thirty-four belonging to *Eutaenia* or garter snakes alone.

When I first heard of this curious habit, years ago, I was inclined to be sceptical of its truth, though since I was bitten on the end of my thumb by a *blind* and *decapitated* rattlesnake (*Crotalus adamanteus*), I have come to the conclusion that these reptiles are liable to do most anything. The venomous species should be killed whenever possible, but the small, harmless species should never be molested. Automobiles kill more people in one year in the United States than all the venomous snakes within that territory do in twenty.

"SPREADING ADDER." "BLOWING VIPER"

HETERODON PLATYRHINUS, *Lat.*

BY CHAS. DURY

I was recently asked the question, "Do any of our snakes hiss?" The species that most frequently does so is the above. September 11, 1909, I came suddenly near one of these snakes. It was in a ravine alongside of a woods. I intercepted the retreat of the snake by holding my net in front of it. Instantly it coiled, flattened its head and body laterally and emitted a disagreeable odor and a series of hissing sounds interspersed with blowing puffs. The mouth was opened in a very threatening manner. Finding I was not to be frightened in this way, it changed its tactics entirely by resuming its normal circumference, turning on its back and feigning death, laying limp and motionless with mouth partly open and tongue hanging out. I picked it up, examined its teeth and body, then laid it down on its back and watched it. After a few minutes it began to slowly turn its head, but when I made a movement it dropped back into its apparently lifeless condition again. This was repeated several times, so I was convinced that it was an ingenious attempt to deceive me and thus escape. I withdrew a short distance and kept motionless and had the satisfaction of seeing this ill-looking but harmless creature glide away to a place of safety.

In 1906, in the same woods (the only locality, now, where I ever see *Heterodon* in the vicinity of Cincinnati), I came onto a large specimen of this species. It started for a brush heap. To intercept it, I tapped it lightly on the head, when it rolled over apparently dead. Fearing I had killed it, and after an examination of its mouth and teeth, I placed it in a safe place and left it. When I returned it was gone. I am sure it was playing "possum." Never destroy a harmless snake.

VIRGINIA OR RED DEER

ODOCOILEUS VIRGINIANUS, in Ohio

BY CHAS. DURY

This graceful and beautiful deer, once so abundant in Ohio, has now become scarce to the verge of extinction. Forty years ago it was yet to be found in numbers in certain parts of the state. As late as 1868, in Paulding, Henry, Jackson, Adams, Scioto, Pike and other counties there were many wild deer left. In December, 1872, with a light snow covering the ground, in Mercer Co., I found it an easy matter to trail them though the animals were very shy and wary and had the habit of lying down in the tops of fallen trees or in thickets. When the hunter approached their place of concealment, even though a long distance away, the deer would bound out from the opposite side of the thicket and soon leave its pursuers far behind, repeating the same maneuver whenever the hunter came too close. The leaps and bounds over obstructions, made by a frightened deer, are astonishing, but as the animal leaves the hunter or dog in the distance, it quickly diminishes its pace, as it seems to tire quickly when pursued.

Still-hunting the Virginia deer was the usual method employed in their capture, though dogs were sometimes used to drive the game past certain points called "stands," where it was thought the deer would be likely to run. Here the hunter concealed himself and shot the animal as it ran past.

Another method was to watch a "salt lick," which was a salty place in the ground. To such places the animals came to lick salt, of which they were very fond. The hunter concealed himself so as to get a shot at the deer when it appeared. Deer hunting was hard work, requiring great patience, accuracy and endurance; so much so that I seldom indulged in it, contenting myself with smaller game, which was then very abundant.

In early days the muzzle-loading rifle was used in still-hunting deer, but when shotguns came into use in Ohio, they were

used, loaded with a charge of buckshot, and were particularly effective when driving deer with dogs.

The deer subsists on tender vegetation of various kinds, and is careful to select that which is suited to its taste. It is particularly fond of plants and grasses growing in wet and swampy places. In winter, when snow covers the ground, it feeds on twigs, half-dried grasses, mast and anything it can get. Some of the stomachs examined presented a curious mixture.

The animals become fat in the fall, and as the rutting season comes on in November, they are in their finest condition. The necks of the bucks swell, and they are very pugnacious, fighting each other with great fury. It sometimes happens, in these battles, that their horns become interlocked, so that it is impossible to separate them, and the animals perish as a result. I have seen several pairs that were found in such a condition. The horns of two of these fighting bucks, in the Museum of the Cincinnati Society of Natural History, are so firmly locked together that it is impossible to get them apart without breaking. The animals evidently rushed together with such force that the impact sprung one pair apart and the other pair together, causing them to be locked in the manner described. The two sets of horns are evenly matched, and probably belonged to rival bucks of about the same size and age. Two pairs in the Cuvier Club Museum in Cincinnati show a similar condition. Another pair of interlocked horns were found in Michigan in 1905. "These animals were discovered by a hunter after they had been dead for several days. The man who found them said it looked to him as though one had died several days before the other. One of the points of one deer penetrated the jaw of the other, breaking it. One of the points of the other, which was a double point, penetrated the head of its enemy half way between the eye and nostril. The harder they pulled to get apart, the deeper the points penetrated into each other's head." The horns of this deer are shed in the winter or spring and come off at the burr, which is close to the skull. In the

spring the new horns begin to grow. During this growth, which is very rapid, the horn is covered with a soft, thick, fleshy skin, which is abundantly supplied with blood vessels, and the surface is covered with a growth of closely-set hair, which is called the "velvet." If this vascular skin is wounded or lacerated in any way it bleeds very freely. By the time the horns are fully grown the blood vessels close of themselves and the blood supply to them is cut off, the skin dries and sloughs off, a process that the animals hasten by rubbing their horns against trees, bushes and the ground. In taking hold of the horns during the growth of this vascular skin, I have noticed they felt very hot to the touch, indicating a vigorous circulation.

For a more minute account of the life history of this deer, see the excellent work on the "Antelope and Deer of America," by John Dean Caton, LL. D., published in New York in 1877.

The following observations on the Virginia deer have been made in the Cincinnati Zoological Garden, running over a period of many years. In the healthy and vigorous animal the horns are shed from the first to the middle of May. If vitality is impaired in any way, it is sometimes later. The new horns begin to grow at once, and during the summer are in the "velvet." When the horns are grown the "velvet" dries up and begins to peel off. By December it is all off and the horns are hardened. The rutting season then begins. The young are born in June.

The Virginia deer in captivity, though a native species, is one of the most difficult to keep in good condition during the summer, and not until cool weather comes, in the fall, do they get sleek and fat. In this respect they are different from the several exotic deer, usually kept in the Garden, which seem to retain their good appearance throughout the year. The color of the pelage in Ohio specimens varies from chestnut red in summer to yellowish gray in winter. They are difficult to tame unless taken very young. They can then be tamed completely, and while young make amiable and interesting pets, but as they get older they become a nuisance in various ways.

A neighbor, near my home, had one for a pet, and its favorite amusement was to sneak into the house whenever a door was left open. When an attempt was made to drive the intruder out, it had a habit of jumping through a window without the formality of a sash being raised. But this habit proved its destruction at last, as a sharp piece of broken glass penetrated its lung, causing its death. This animal was a doe. The adult pet buck is very apt to be dangerous at certain seasons, and is anything but a desirable pet.

The flesh of a young and fat Virginia deer is extremely juicy and delicious. When broiled it is the most nutritious and easily digested meat I have ever eaten, and I think far superior to the venison of the "mule deer" of the West.

The deer feeds in the early morning and late in the evening, and is rather nocturnal in its habits. This is particularly the case when they are much hunted or disturbed. During the middle of the day they rest concealed in some thicket or fallen tree top. The note of the buck is a shrill whistling sound; that of the doe, a bleat like a calf in distress, but it is rare that the doe makes any sound.

When deer were abundant in Ohio, Kentucky and West Virginia, they frequently swam across the Ohio River.

Mr. E. W. Knight, of Charleston, W. Va., who has hunted them in West Virginia, has written me in regard to the scarcity of deer. He says he does not think there are now any wild deer within twenty miles of the Ohio River in West Virginia. He says deer are decreasing in most parts of his state very fast.

In early times, before the day of the deadly and destructive firearms, this species was evidently very abundant in the Ohio and Miami valleys, indicated by the great quantities of crania and other bones found in excavating in the ancient cemetery near Batavia Junction, Hamilton Co., Ohio, and other places, many of the bones being manufactured into various implements by the race of people who have, like the deer, long since become extinct in the locality. But from the conditions surrounding

these bone heaps, these animals doubtless furnished one of the most important articles of food for these primitive people. For figures and descriptions of some of these curious implements made from bones of deer, see the JOURNAL of the Cincinnati Society of Natural History, Vol. III, 1880.

There is also a fine collection of these bone implements preserved in the Museum of the Society in Cincinnati.

The following records show the occurrence of the species in the State since 1825. In History of Knox County, Hill says:

"Deer were abundant in Harrison Township in 1825. John Schooler shot twenty-three that fall. Last one killed by David Ash on farm now owned by Geo. Milligan, in 1834. Deer were killed in Brown Township as late as 1840."

Dr. Kirtland, in Ohio Zoological Report for 1839, says: "The common deer is comparatively rare."

Eugene F. Cranz, Ira, Ohio, says: "The last deer was killed in this vicinity in 1844."

Geo. M. Austin, Wilmington, Ohio, says: "The last one was killed here by Jas. Hartman, in Adams Township, in 1863."

Mr. S. R. Grimes, of Mineral Springs, Adams Co., Ohio, writes me, December 16, 1905, in regard to deer in Ohio, as follows: "The last deer killed in this neighborhood was in 1884. Forty years ago deer were very plentiful here. There was a deer lick on the ground where this hotel now stands. Twenty miles east of here, in Scioto Co., at Friendship P. O., deer were killed in winter of 1904. I am told there are yet a few deer in the extensive forests extending from the Ohio River into Pike Co., through Scioto and Adams Cos., into Ross Co."

Mr. W. F. Henninger says. "In the fall of 1900 three or four deer came up from Kentucky through Adams Co. Lost track of them near Greenville."

Henry Moor shot a deer in Pike Co. in 1852.

E. L. Smith, Berea, Ohio, says: "Last deer killed here in 1855."

Thos. Miskell, Wauseon, Ohio, says: "About ten years ago (1895) was the last time I have heard of a deer in this (Fulton) county."

In 1869 a wild deer ran down the lane leading to the farm of Thos. Bown, which was situated five miles south of Charleston, in Clark Co. The boys started in pursuit, but the deer, after leaping several fences, easily escaped.

Dr. Howard Jones of Circleville, Ohio, reported deer abundant in the Jackson Hills January 8, 1881.

Wm. Leaming, of Milton Center, Wood Co., Ohio, killed a deer in Jackson Township on Thanksgiving Day, 1884, and in December, 1886, Thos. Morrison killed another. As late as the winter of 1904 a buck was killed in Jackson Co., Ohio, and the head was sent to Cincinnati to be mounted.

I have been asked the question: "If deer and elk shed their horns each year, why are not more of the cast-off horns found in the woods?" I once saw an explanation of this, while hunting deer in Colorado. A huge elk had cast its horn on the edge of a mesa. The rodents had gnawed it, as they generally do, to wear down their incisor teeth. The sun had bleached and cracked it. The rains had soaked its porous parts, and the frost had disintegrated it. The crumbling fragments were being overgrown and covered up, fast disappearing from sight, suggestive of the fate of North America's largest and grandest game animals.

A NEW BIRD ENEMY

By Dr. Wm. C. Herman, M. D.

While photographing a nest containing three young cardinals *(Cardinalis cardinalis)* three or four days old, an unusual incident was observed. This nest was in a clump of blackberry bushes about three feet high. My camera was set up and focused, my object being to secure a photograph of the parent birds feeding their nestlings. After making several exposures of the male bird feeding the young with grasshoppers, the parent birds became somewhat shy, the female not approaching at all. For this reason I left the vicinity of the nest for about fifteen minutes. When, on my return, to my great amazement, I discovered that a large green beetle called the caterpiller hunter (*Calosoma scrutator,* Fab.) was attacking the nestlings. This beetle had lacerated the tender throat of two of the defenseless birds, and was sucking the blood. Both of the birds were killed in exactly the same manner. I attempted to capture the marauder, but it escaped, emitting a nauseating odor. The birds were still warm when I examined them. The parent birds were not in sight when the insect destroyed their young. It is very unusual for this beetle to attack young birds, and to my knowledge has not been observed before.

21 East Seventh St., Cincinnati, Ohio.

VOL. XXI. No. 3.

THE JOURNAL

OF THE

Cincinnati Society of Natural History

...Published December, 1912...

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JOSUA LINDAHL, A. M., Ph. D.

JOSUA LINDAHL, A. M., Ph. D.

Dr. (Johan Harald) Josua Lindahl, for eleven years the Director of the Museum of the Cincinnati Society of Natural History, died in the City of Chicago, of bronchial pneumonia, on April 18, 1912. From the family it is learned that his illness was short. He contracted a cold on the 11th of April; he took to his bed on the 14th; later pneumonia set in, and on the evening of the 18th he passed away without suffering.

Dr. Lindahl was a man of rare scientific attainments and won for himself distinction on two continents. His earliest claim to recognition was as a zoologist.

Born at Kungsbacka, Sweden, on January 1, 1844, he received his education at the Royal University at Lund. This institution conferred on him the degree of A. B. in 1863. In 1870, he accompanied Gwyn-Jeffries and Carpenter, as assistant zoologist in the British deep sea exploring expedition in H. M. S. Porcupine. In 1871, he was the zoologist in charge of an expedition to Greenland in Swedish warships Ingegard and Gladan. In 1874 he was instructor in zoology at the Royal University, and there received the degrees of A. M. and Ph. D. In 1875 he was the Secretary of the Royal Swedish delegation to the International Geographical Congress at Paris. Later in the year 1875, and until some time in 1877, he was the Secretary of the Royal Swedish Commission to the Centennial Exposition in Philadelphia. After the work of the Commission was ended in 1877, he concluded to remain in this country, only returning to Sweden to be married. His wife was Sophie, the daughter of Major C. A. Pahlman, a woman of noble birth and of charming personality. Mrs. Lindahl died September 15, 1909. Soon after his marriage, he brought his bride to America, and from 1878 to 1888 he was Professor of Natural Sciences at Augustana College at Rock Island, Illinois. The following five years, or until 1893,

he was Curator of the Illinois State Museum of Natural History at Springfield. During the year 1891 he was Professor of Greek in Augustana College, and the following year he was Professor of Botany at Martin Luther College, Chicago. Late in the year 1895 he became the Director of the Museum of the Cincinnati Society of Natural History, and continued until 1906, when he removed to Chicago, and set up a laboratory for the manufacture in America of a chemical preparation known as Salubrin, after the formula of his friend, Dr. Håkansson, of Eslöf, Sweden. He was manager of this laboratory at the time of his death. In forty-two years of active participation in the world's affairs, he had contributed in no small way to the advancement of human knowledge. His mind seemed specially adapted to the reception and rapid assimilation of scientific intelligence of any character. He was intensely interested in every phase of scientific endeavor. His place among the scientists of his day was fittingly recognized, when, in 1876, he was made a member of the French Academy of Sciences, upon whose lists are inscribed the names of such zoologists as Baron Georges Cuvier and the two Geoffroy-Saint Hilaires. Two years later, in 1878, he was decorated by King Oscar II of Sweden with the Royal Order of Vasa. He served a term as the President of the Swedish Historical Society of America, and in 1900 he was President of the Ohio Academy of Science. He was a member of the American Society of Vertebrate Paleontologists; of the American Association of Museums, and of the American Association for the Advancement of Science. In 1908 he was elected a life member of the Cincinnati Society of Natural History. He was the author of various scientific papers and a frequent contributor to American and European scientific journals. His place among the men of science of his day is secure. In this Society, which he served so long and well, he is held in most affectionate remembrance. He came among us a total stranger, but speedily won our admiration and regard. He was as gentle and lovable in disposition as a child and compelled the instant affection of

all who came in contact with him. His quiet and modest demeanor and want of aggressiveness doubtless lost him some prizes in life to which he was entitled. No one who ever enjoyed the pleasure of an intimate acquaintance with him would rank him far below the highest in the field of natural science. While not given to boasting of himself, it is well known that he was very proud of the fact that he was a fellow-countryman of the celebrated naturalist, Linnæus.

When he came to the Society of Natural History, it was discovered that he was much larger than the position which he was called upon to fill. Nevertheless, he gave freely of his great knowledge, and took up the work he found awaiting him with enthusiasm. He left his impress upon the Society as the Director of its work, and there radiated from him an atmosphere of learning and refinement which was most delightful. The Cincinnati Society of Natural History mourns the loss to science of the taking off of such a man as Dr. Lindahl.

Cincinnati, May 8, 1912.

NOTES ON NORTH AMERICAN SPECIES OF NEPTICULA, WITH DESCRIPTIONS OF NEW SPECIES

(Lepidoptera)

By Annette F. Braun

Owing to the difficulty in rearing many of the species of this genus, especially those that are one-brooded and pass the winter as full-fed larvæ within the cocoons, the practice of naming species from the mine and larva has been all too prevalent. Clemens and Chambers have been the chief offenders in this regard, and thirteen such names are credited to them on our lists. A few of these species were afterwards bred and their descriptions published. It is reasonable to suppose that some of them when bred will be found identical with species named from flown specimens with no knowledge of the life history. Until this breeding is done, our knowledge of this genus must remain in its present confused and unsatisfactory state. To avoid further confusion in a genus where the species bear such close resemblance to one another, nothing more should be described unless the complete life history is known.

The writer of the present paper has been making an effort to breed these incompletely known species, and to determine whether they have been described in other stages. In the progress of the work a number of species not hitherto recorded have been noticed and the imagoes successfully reared. It has been thought advisable to publish the descriptions of these new species, since their complete life history is known. Many other mines, not noted by other authors, have been observed, both in the vicinity of Cincinnati and elsewhere, leading one to conclude that the genus is represented by a vastly greater number of species than our check lists show.

Of the fifteen species to which reference is made in the following paper, ten are entirely new, five were previously described only in the larval state. Two of these last five are identical with species bred and described under other names.

The number of species now known only in the larval state is thus reduced to six, *juglandifoliella* Clemens having been later described by Chambers and *nyssæfoliella* Chambers by the writer.

Nepticula pallida, **n. sp.**

Palpi pale ocherous. Tuft yellowish, the scales on the vertex tipped with orange. Antennæ pale ocherous, eye-caps whitish. Thorax very pale tawny.

Fore wings very pale tawny, with a very faint metallic luster, the scales tipped with pale ash-brown, more deeply so toward the apex of the wing, so that although the wing is mottled, the general color becomes deeper toward the apex. Cilia very pale tawny. Hind wings pale gray, tinged with ocherous.

Legs and abdomen very pale straw-colored.

Expanse: 4 mm.

Described from one specimen bred on a narrow-leaved willow, *Salix* sp., from Cedar Point, O., on the lake shore. The mine occurs on the lower side of the leaf and is extremely narrow at first, extending along the midrib, later doubling on

Mine of *N. pallida.*

itself once or twice, and gradually and evenly increasing in breadth to its end, where it measures a scant 1.5 mm. across. The entire length of the mine is approximately 1.5 cm. The color is brownish throughout and not at all transparent. The frass is distributed in a broad tract throughout the entire length of the mine. The larva spins an oval reddish brown cocoon, without projecting ridges.

This species is most closely related to *N. populetorum* F. and B. from which it may be distinguished by the paler color, in particular by the paler frontal tuft. The mine is decidedly different in appearance.

Type in my collection.

NEPTICULA DISCOLORELLA, **n. sp.**

Palpi whitish. Tuft reddish ocherous. Antennæ dark brown, eye-caps shining whitish. Thorax dark brown.

Fore wings plum-colored, with the scales especially in the apical third tipped with black, so that, under a moderately strong lens, the wing has a very finely peppered appearance. The basal portion of the wing is thus rather paler than the apical portion beyond the fascia. At about three-fifths its length, the wing is crossed by a narrow, outwardly curved, whitish fascia, scarcely shining. The cilia are gray, becoming paler toward the apex, where they are of a sordid white color. Hind wings moderately dark gray.

Legs shining pale gray. Abdomen blackish above, shining gray beneath.

Expanse: 5 mm.

The above description is made from two specimens bred from upper side mines on leaves of *Salix discolor* Muhl., the "pussy willow," at Cincinnati. The mine begins as an extremely narrow linear mine, continuing thus for a distance of about 1.5 cm., during which its breadth is scarcely increased, then suddenly expands into a blotch about 1 cm. long, 2 mm. wide at its beginning, and about 5 mm. wide at the end. The blotch is semitransparent and within it the frass is deposited in sinuous curves. The cocoon is dark brown, somewhat wedge-shaped, rounded at its anterior end, and not much flattened.

Mine of *N. discolorella*

This is apparently a very scarce species, as I have observed but few of the mines, and only on leaves of this species of willow. The mines were collected on the 9th of July, and the imagoes appeared on the 25th and 26th of the same month.

The darker apical portion of the wing and the dull, scarcely lustrous appearance of the wing, including the fascia and cilia, are the distinguishing characteristics of this species. Although I have not seen the type of *Nepticula minimella* Chambers, I

should regard it, judging from the rather meager description, as closely related to the present species.

Types in my collection.

NEPTICULA ULMELLA, **n. sp.**

Palpi creamy white. Tuft ocherous tinged with red above, and sometimes with a few dark brown scales behind. Antennæ creamy white, broadly banded above with dark brown, so that only a narrow line of the pale color appears between the annulations. Eye-caps creamy white. Thorax brownish, somewhat peppered.

Scales of the fore wing creamy white, shading to dark brown at their tips, except where they form a creamy white oblique fascia at the middle of the wing. The general color of the fore wing is thus a somewhat mottled dark brown. The fascia, beginning at the middle of the wing on the costa, reaches the dorsum somewhat behind the middle, and is sometimes broken with a few dark-tipped scales. Cilia creamy white. Hind wings pale gray, with a pale bluish luster.

Legs creamy white. Abdomen above gray, beneath pale straw-colored.

Expanse: 4-4.5 mm.

The two type specimens of this species were bred from mines on red elm, *Ulmus fulva* Michx., at Cincinnati. The mine starts as a very fine brown, or rarely whitish, line, not very winding in its early course, and at about half its length abruptly enlarging to a breadth of 1 mm. From thence it continues to increase gradually in width, until it attains a breadth slightly in excess of 2 mm. The broad portion of the mine is usually so much contorted, that it is not possible to trace the course of the mine, the whole having the appearance of an irregular blotch. The cocoon is reddish brown, much flattened and is almost circular in outline. Contrary to the usual

Mine of *N. ulmella.*

habit among the American species that I have observed, a large proportion of the larvæ spin cocoons within the mines, generally in the center of the blotch. This is especially true of the generation which passes the winter in the cocoon.

Three captured specimens in my collection are identical with the two bred specimens, but are a little larger, measuring 5 mm. in expanse. The most distinctive features of this species and those which easily distinguish it, are the entire absence of luster, the irregular creamy white fascia formed from scales lacking the dark tips present on the remainder of the wing, and the creamy white cilia. This species is most closely allied to that form of *N. platanella* Clem. in which there is a complete fascia, but differs from it in the paler bases of the scales of the wing and in the conspicuously creamy white cilia.

Types in my collection.

NEPTICULA LEUCOSTIGMA, n. sp.

Palpi very pale gray tinged with ocherous. Tuft reddish ocherous, collar creamy white. Antennæ dark brown, faintly annulate with a paler shade; eye-caps yellowish white. Thorax dark purplish brown.

Fore wings dark brown, with a faint purple luster. Beyond the middle of the wing there is a narrow, faintly shining white fascia, convex outwardly and placed somewhat obliquely on the wing, reaching the margin farther from the base on the dorsum. The scales at the extreme tip of the wing are white, forming, with the whitish apical cilia, a very distinct pale patch. The cilia, except at the apex as just described, are gray. Hind wings and cilia dark gray.

Legs shining grayish ocherous, hind femur creamy white, hind tarsi dark gray. Abdomen dark purplish above, pale beneath.

Expanse: 4 mm.

Described from one specimen bred from an upper side serpentine mine on red elm, *Ulmus fulva* Michx., at Cincinnati. The mine increases very gradually in breadth and is pale brown in color with a conspicuous dark brown line of frass through the middle. The cocoon is ovoid, dark brown.

Mine of *N. leucostigma*.

The distinguishing characteristics of this species are the whitish collar and the white apical spot.

Type in my collection.

NEPTICULA ROSÆFOLIELLA CLEMENS.

Nepticula rosæfoliella Clemens, Proc. Ent. Soc. Phil., I, 85, 1861; Tin. No. Am., 176, 1872; Dyar, List N. A. Lep., No. 6218, 1902.

This is one of the species named from mine and larva only. Clemens found the mines in leaves of *Rosa lucida* in September. On leaves of *Rosa setigera* Michx. in July and October I have found mines agreeing exactly with Clemens' description, in which he says: "The mine is very serpentine, frequently running around the edge of the leaf including its teeth, moderately broad, nearly filled with a broad blackish-brown frass line, the grains of which are dispersed or have a wavy arrangement in the later part of the mine. In the early portion, the tract is filled with the excrement of the larva." Just before its end, which is often slightly enlarged, the mine measures about 1.5 mm. in width. The larva forms a flattened, yellowish brown cocoon, elliptical in outline with a distinct projecting edge extending entirely around it. The imago may be described as follows:

Mine of *N. rosæfoliella*.

Palpi whitish. Tuft ocherous, reddish on the vertex. Antennæ black, eye-caps shining creamy white. Thorax black.

Fore wings almost black, lustrous, with a very faint dark blue tinge in the basal portion. Just beyond the middle of the wing is a rather broad straight silvery or very pale golden fascia. Cilia of the general hue, scarcely paler tipped opposite the apex. Hind wings dark gray.

Fore pair of legs gray, middle and hind pair silvery, hind tibiæ and tarsi black above. Abdomen black, silvery gray beneath.

Expanse: 4.5 mm.

The conspicuous silvery fascia and the almost entire absence of pale tips of the apical cilia, probably are the most distinguishing features of the species. Of the described species it comes nearest to *N. fuscotibiella* Clem.

NEPTICULA TILIELLA, n. sp.

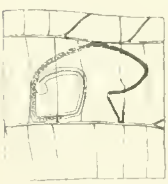
Palpi whitish. Tuft reddish ocherous, whitish behind. Antennæ black, eye-caps shining white. Thorax black.

Fore wings almost jet black, with a very faint purple luster. There is a very shining pure white fascia, a little convex outwardly, at the middle of the wing. Cilia gray on the dorsum, shining white from the tornus to the costa. Hind wings and cilia gray.

Legs silvery gray, tinged with ocher, hind tibiæ and tarsi blackish above. Abdomen blackish above, silvery gray beneath.

Expanse: 3.5 mm.

Three specimens bred from serpentine mines on the upper side of leaves of basswood, *Tilia americana* L., Clermont Co., O. The mines in some portions of their course show a tendency toward a spiral form, with either the early or the later portion inside. Another striking feature is the frequency of angular, almost right-angled turns, in the mine. The frass at the beginning is deposited in a line through the middle, later it is dispersed in separate grains or zigzag lines throughout the entire breadth.



Mine of *N. tiliella.*

Over the last 10 or 12 mm. of the mine, it is deposited in a fine black line through the middle. The cocoon is reddish brown, often with a decidedly carmine tinge, oval and somewhat flattened.

The pure white lustrous fascia (without a trace of golden) and the white shining cilia distinguish this species from any other I have seen.

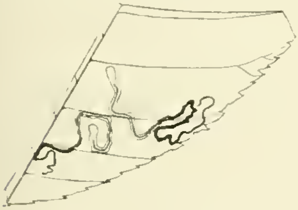
Types in my collection.

Nepticula juglandifoliella Clemens.

Nepticula juglandifoliella Clemens, Proc. Ent. Soc. Phil., I, 84, 1861; Tin. No. Am., 173, 1872; Chambers, Bull. Geol. Surv. Terr., IV, 105, 1878; Dyar, List N. A. Lep., No. 6199, 1902.

Syn. *caryæfoliella* Clemens, Proc. Ent. Soc. Phil., I, 84, 1861; Tin. No. Am., 174, 1872; Dyar, List N. A. Lep., No. 6190, 1902.

Chambers has accurately described this species, which Clemens named *juglandifoliella* from a knowledge of the mine and larva only. Mines on hickory, similar to those described by Clemens, to which he gave the name *caryæfoliella*, have yielded specimens differing in no respect from those bred on walnut, and therefore *caryæfoliella* Clem. must be regarded as a synonym of *juglandifoliella* Clem.



Mine of *N. juglandifoliella.*

As Chambers has noted under his description of *N. juglandifoliella*, several mines usually occur on a leaflet of walnut, crossing and recrossing one another until it is scarcely possible to trace the separate mines. There may be as many as a dozen mines on a single leaflet. I have not observed this peculiarity on hickory leaves; there is usually but one mine on a leaflet, rarely two or three may be found together. The cocoon is small, brownish red and somewhat flattened.

Nepticula virginiella Clemens.

Nepticula virginiella Clemens, Proc. Ent. Soc. Phil., 1, 83, 1861; Tin. No. Am., 172, 1872; Dyar, List N. A. Lep., No. 6225, 1902.

I have bred several moths from mines on *Ostrya,* agreeing with Clemens' description of the mine, made by the larva to which he gave the name *virginiella.* The larva spins a flattened brownish yellow cocoon with a ridge around the broader anterior end. The imago may be characterized thus:

Mine of *N. virginiella.*

Palpi whitish. Tuft reddish ocherous. Antennæ fuscous, eye-caps yellowish white. Thorax blackish, with golden and purple reflections.

The basal portion of the fore wing shows strong bronzy, purple or blue reflections according to the incidence of the light: in the apical portion the purple and blue reflections alone are present. There is a brilliant, very pale golden fascia just beyond the middle, narrowed toward the costa. Cilia gray, tipped with silver, deeply so around the apex. Hind wings and cilia gray.

Fore and hind pair of legs shaded with dark gray, middle pair of legs shining yellowish. Abdomen dark purplish above, iridescent gray beneath.

Expanse: 3.5 mm.

These specimens come very close to *N. apicialbella* Cham., and it is possible that a comparison with the type of *N. apicialbella* would show them to be identical.

Nepticula corylifoliella Clemens.

Nepticula corylifoliella Clemens, Proc. Ent. Soc. Phil., 1, 83, 1861; Tin. No. Am., 172, 1872; Packard, Guide Stud. Ins., 356, 1869; Dyar; List N. A. Lep., No. 6193, 1902.

Mine of *N. corylifoliella.*

This species was named from a knowledge of the mine and larva only. I have bred a single specimen from a mine on hazel answering the description of Clemens' *corylifoliella.* While very closely resembling *N. virginiella,* the moth differs from it decidedly in the color of the antennal eye-caps.

Palpi silvery gray. Tuft reddish ocherous. Antennæ bronzy black, eye-caps whitish ocherous, shading to black outwardly. Thorax deep bronzy brown, with purple and green reflections.

Fore wings deep bronze brown, with purple and green reflections, the purple predominating beyond the fascia, which is pale golden, very lustrous, and is placed just beyond the middle of the wing. The fascia is almost straight, distinctly narrower on the costa. Dorsal cilia gray, cilia around the apex silvery white. Hind wings gray, with faint purple reflections.

Fore pair of legs and hind legs, except the tarsi, purplish black, middle pair of legs and hind tarsi silvery gray. Abdomen above purple, beneath paler and bronzy.

Expanse: 3.5 mm.

The entire insect is somewhat darker than *N. virginiella* but the dark antennal eye-caps in particular distinguish it from that species.

Nepticula rhoifoliella, n. sp.

Palpi whitish. Tuft black. Antennæ black, eye-caps white. Thorax blackish purple.

Fore wings very lustrous, base of the costa purple. A large, semi-elliptical patch of scales just beyond the base of the wing and resting on the dorsum, but not reaching to the costa, is deep brilliant golden, shading along its edges into bronze, which forms the general ground color of the wing.

This golden patch, while it does not constitute a definitely limited marking, is nevertheless distinctly differentiated from the rest of the wing. A straight shining silvery or pale golden fascia crosses the wing at three-fifths its length. Cilia of the general hue, the tips but little paler around the apex. Hind wings and cilia gray.

Legs black, except the tibiæ and tarsi of the middle pair, which are silvery. Abdomen blackish above, somewhat paler beneath.

Expanse: 3.5 mm.

Eight specimens of this species were bred from much contorted serpentine mines on the upper side of leaves of poison ivy, *Rhus radicans* L., at Cincinnati. The loosened epidermis is pale brownish yellow and the frass is dispersed, in most places, throughout the entire breadth of the mine. The cocoon is reddish ocherous, not much flattened and is a little broader at its anterior end. Similar mines occur on species of sumac (*Rhus* spp.), which will doubtless produce moths of this species. Chambers (Psyche, III, 66, 1880) briefly mentions such mines on sumac.

Mine of *N. rhoifoliella.*

This species is very distinct from any other described species. Its striking characteristics are the black head, purple base of the costa and the golden patch of scales, the last standing out even to the naked eye as paler and more lustrous than the remainder of the wing.

Types in my collection.

Nepticula villosella Clemens.

Nepticula villosella Clemens, Proc. Ent. Soc. Phil., I, 84. 1861; Tin. No. Am., 174, 1872; Dyar, List N. A. Lep., No. 6224, 1902.

Syn. *dallasiana* Frey and Boll, Stett. ent. Zeit., XXXVII, 228, 1876; Dyar, List N. A. Lep., No. 6195, 1902.

Clemens named this species from mine and larva only; later it was described under the name *dallasiana* by Frey and Boll from imagoes bred on blackberry in Texas. The species also occurs at Cincinnati, and agrees exactly with Frey and Boll's description of *N. dallasiana.* The mine is found most commonly on blackberry, but also occasionally on black raspberry (*Rubus occidentalis* L.); it is a long, very narrow serpentine tract. There is great variation in size among the imagoes; one captured specimen in my collection expands 7 mm.; the other extreme is represented by a specimen from raspberry, measuring 3 mm. in expanse.

Nepticula obscurella, n. sp.

Palpi grayish, paler at their tips. Tuft ocherous. Antennæ brownish, eye-caps whitish. Thorax brown.

Fore wings shining seal brown, tinged with red toward the apex. At the apical fourth of the wing there is an indistinct narrow whitish fascia, broadest in the middle of the wing and fading out toward the ends. When viewed at some angles this fascia is scarcely visible. Cilia of the general hue, their tips paler and concolorous with the fascia. Hind wings grayish brown.

Legs gray, tibiæ and tarsi pale. Abdomen brown.

Expanse: 3.5 mm.

Described from one specimen, bred from a rather short serpentine mine on *Myrica* sp. from Montclair, N. J. The cocoon is ocherous, flattened, with a projecting ridge at the anterior end. The leaf of *Myrica* containing the *Nepticula* mine was received with other mines from Mr. W. D. Kearfott in October, 1907. The imago appeared the following spring.

This species differs from *Nepticula myricafoliella* Busck, bred on *Myrica cerifera* in Florida, in the color of the wings and in the position and shape of the pale fascia.

Type in my collection.

NEPTICULA RHAMNELLA, n. sp.

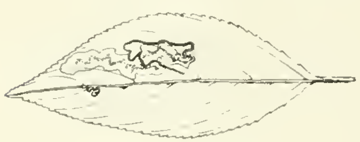
Palpi pale straw-colored, tinged with gray. Tuft reddish ocherous. Antennæ black narrowly ringed with pale gray, eye-caps pale straw-colored. Thorax pale straw-colored, patagia dark brown.

Fore wings brown, the tips of the scales blackish. At the basal third of the wing is a dull pale straw-colored fascia with its edges often indented by dark scales. At two-thirds of the wing length is a much broader and more conspicuous shining silvery fascia. Cilia pale gray, whitish around the apex. Hind wings and cilia rather pale gray.

Fore and middle pair of legs ocherous, somewhat shaded with gray, hind pair predominately gray. Abdomen brown above, paler and more ocherous beneath.

Expanse: 4.5-4.8 mm.

Described from six specimens bred from mines on leaves of *Rhamnus lanceolata* Pursh., growing along the Little Miami River, near Milford, O. The egg is deposited on the under side of the leaf, and the larva upon hatching makes a short contorted mine within a small area, so that its presence is indicated from above by a blackish discolored spot on the leaf; the mine then extends as a fine line nearly straight for a distance of about 1.5 cm.; during this time it is not visible on the upper surface of the leaf. The larva then crosses to the upper surface, continuing the linear mine for a distance of about 1.5 cm. further. The mine now suddenly expands into a broader tract or blotch, and from thence to its end has a width of from 2 to 3 mm. The length of the broad tract is about 2 cm. and in it the entire parenchyma is consumed, leaving merely the pale green upper and lower epidermis of the leaf. The frass is here deposited in a wavy line through



Mine of *N. rhamnella.*

the middle. The formation of the blotch occupies approximately the last two days of the larval period within the mine. The cocoon is ocherous, somewhat flattened and broader at its anterior end.

This species is most nearly related to *N. diffasciæ* Braun from California.

Types in my collection.

Nepticula saccharella, n. sp.

Palpi whitish. Tuft brownish ocherous. Antennæ brownish ocherous broadly ringed with black; eye-caps silvery white, with a bluish luster. Thorax with a bright blue metallic luster.

Basal fourth of the fore wing shining with a bright blue metallic luster. Ground color of the remainder of the wing black, faintly shining. There is a rather broad shining silvery fascia just beyond the middle of the wing, broadening and curving toward the base as it approaches the dorsum. When viewed at some angles, this fascia shows pale blue reflections. Cilia pale bluish shining, and with a line of dark scales through their middle. Hind wings and cilia gray, with a bluish luster.

Legs pale, streaked with dark above. Abdomen dark brown above with a faint bluish luster, much paler beneath and bluish.

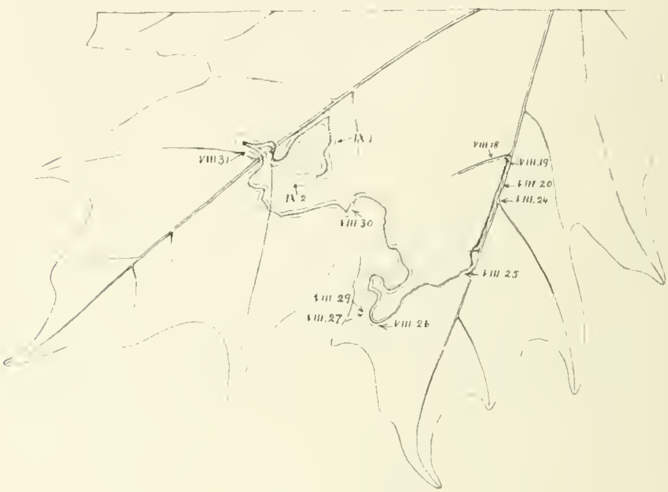
Expanse: 4 mm.

Seven specimens, six of them bred from very long serpentine mines on the upper side of sugar maple, *Acer saccharum* Marsh. The egg is deposited on the under surface of the leaf, but the larva crosses to the upper side immediately on hatching, so that the mine is strictly an upper side mine. The loosened epidermis is greenish, and a dark line of frass extends through the middle of the mine. The mine is 13-14 cm. in length. This is without doubt the mine noticed by

Chambers on sugar maple (Psyche, III, 66, 1880). The cocoon is ocherous, much flattened, very regularly oval in outline, and has a very distinct broad projecting rim extending entirely around it.

Types in my collection.

I have made some rather interesting observations on this species in regard to the rate of increase in the length of the mine. These observations were originally undertaken to cor-



Mine of *N. saccharella*.

rect statements made by Chambers as to the extreme shortness of the duration of the larval period in this group, and while entirely refuting his statement that "usually the entire larval life does not exceed thirty-six hours," they are also interesting as a record of the rate of growth of the mine. The observations on each consecutive day were made as far as possible, approximately 24 hours apart. The letters a, a′, b, b′, etc., are used to indicate approximately corresponding ages of the larvæ.

I. Mine collected August 18th.

	Length of mine, Aug. 18th........	.5 cm.
(a)	Increase, Aug. 18-19............	.3 cm.
(b)	Increase, Aug. 19-20............	.3 cm.
(c)	Increase, Aug. 20-24............	.2 cm.

(The greater part of this time was probably taken in moulting.)

(d)	Increase, Aug. 24-25............	1.2 cm.
(e)	Increase, Aug. 25-26............	1.3 cm.
(f)	Increase, Aug. 26-27............	.2 cm.
(g)	Increase, Aug. 27-29............	.0 cm.
	(Representing another moult.)	
(h)	Increase, Aug. 29-30............	2.5 cm.
(i)	Increase, Aug. 30-31............	2.8 cm.
(j)	Increase, Aug. 31-Sept. 1.........	2.7 cm.
(k)	Increase, Sept. 1-2..............	.9 cm.

On Sept. 2d the larva left the mine to pupate.

II. Mine collected September 1st.

	Length of mine, Sept. 1st........	3.9 cm.
(g′)	Increase, Sept. 1-2..............	.0 cm.

(Corresponding to second moulting period noted above.)

	Increase, Sept. 2-3..............	.8 cm.
(h′)	Increase, Sept. 3-4..............	1.1 cm.
(i′)	Increase, Sept. 4-6..............	3.6 cm.
	(No observation made on September 5th.)	
(j′)	Increase, Sept. 6-7..............	2.9 cm.
(k′)	Increase, Sept. 7-8..............	1.2 cm.

The larva left the mine to pupate on Sept. 8th.

III. Mine collected September 1st.

	Length of mine, Sept. 1st........	1.9 cm.
(h″)	Increase, Sept. 1-2..............	1.5 cm.
(i″)	Increase, Sept. 2-3..............	2.1 cm.
(j″)	Increase, Sept. 3-4..............	2.7 cm.
(k″)	Increase, Sept. 4-5..............	2.4 cm.

The larva left the mine to pupate on Sept. 5th.

The above observations would indicate that the mine increases in length by approximately equal increments during each larval instar; following a moult this rate is suddenly increased, but continues nearly constant, very slightly increasing each day until the next moult. A moult appears to occupy between 36 and 48 hours. The amount consumed by the larva is of course not measured directly by the increase in length of the mine, since during the entire period, the mine is regularly increased in breadth.

Nepticula argentifasciella, n. sp.

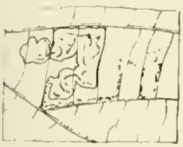
Palpi black. Tuft black behind, reddish orange mixed with dark brown in front. Antennæ black, eye-caps silvery white. Thorax black with slight brassy reflections.

Fore wings black, with reddish metallic reflections when viewed obliquely. At the basal fifth of the wing there is a brilliant silvery fascia, becoming decidedly broader as it nears the dorsum which it reaches at about the inner angle; sometimes it broadens so considerably as almost to reach the base of the wing. At the middle of the wing is a second fascia, in some specimens almost wedge-shaped, with its base resting on the dorsum. At the extreme apex of the wing is a silvery patch of scales of variable extent; in some cases it is merely a rather large spot at the tornus; in others it may extend from the costa around the apex broadening toward the tornus; in a few specimens it is connected along the dorsum by a few silvery scales with the second fascia. The color of these fasciæ varies considerably, depending on the direction of the light, either silver or when viewed very obliquely, a metallic pale blue. Cilia grayish black. Hind wings and cilia grayish black.

Legs black, fore and middle tarsi and last segment of the hind tarsi ocherous. Abdomen black above, sometimes silvery beneath.

Expanse: 4-4.3 mm.

Described from twenty-four specimens bred from mines on leaves of basswood, *Tilia americana* L., at Cincinnati. I have also two captured specimens. The egg is deposited on the upper surface of the leaf, but the larva upon hatching mines much closer to the lower than to the upper epidermis, forming at first a very narrow serpentine mine about 3.5 to 4 cm. in length, with a width nowhere greater than .5 mm. This portion of the mine is scarcely visible from the upper side, except for the tiny specks of leaf substance consumed here and there. Within the last 24 or 36 hours of larval life the linear mine suddenly expands into a blotch or broad tract, 3.5-4 mm. in breadth. In this area, which often obliterates part of the early serpentine mine, the parenchyma is almost entirely consumed, leaving the mine semitransparent and pale green. The larva spins a somewhat flattened reddish cocoon, broader at its anterior end.



Mine of
N. argentifasciella.

Types in my collection.

This species can not be confounded with any of the described species. The silver markings are more brilliantly lustrous than in any other species I have seen.

NEW COLEOPTERA FROM CINCINNATI, OHIO

Family Endomychidæ

By Charles Dury

After many years careful collecting, fifteen species of these interesting beetles have been taken here. Some of them are abundant, though one species belonging to the genus *Anamorphus* has yielded but a single specimen. Prof. L. B. Walton of Gambier, Ohio, has in preparation a Generic Monograph of the family for the Genera insectorum. There will doubtless be some changes in the nomenclature of our lists. Three species of *Symbiotes* Redt. occur here. One of these was also taken at Gambier, Ohio, by Professor Walton, and a description read at meeting of Ohio Academy of Sciences, December 11, 1911, and since then published in *Ohio Naturalist,* Vol. XII, No. 4. The other two described below I have occasionally taken in a certain woods, always in fungus and never associated with ants. The fungus was growing on dead trees and old logs. I find *Endomychids* more abundantly in the fall and early in the spring. Doubtless many of them hybernate, as I have taken them in midwinter clinging to the under side of logs and fence rails left laying on the ground. The species for which I propose the name *impressus* had been identified for me as *pygmæus* Hamp. which is, I believe, a synonym of *gibberosus* Lucas. On comparison with that species it is found to be different. The descriptions follow below.

Symbiotes impressus, n. sp.

Color piceotestaceus, shining, vestiture consisting of long, pale hairs, rather sparse and reclining. Body oval in outline. Antennæ with second joint shorter than first. Third, fourth and fifth equal, subquadrate. Sixth slightly longer. Seventh oval, longer than wide. Eighth subglobose. Ninth subquadrate as wide as long. Tenth slightly wider. Eleventh longer than wide, bluntly pointed. Thorax with sides explanate and arcuate, very minutely punctuate margined at base and

sides. Elytra two and one-half times as long as prothorax and slightly wider. Margin widely explanate. Humeri very prominent. Substriate. Punctures of Elytra dual; the fine ones bearing the hairs. Sutural striæ very deep and punctures fine and feeble. Secondary sexual characters of male. is an impressed glabrous space near tip of each elytron, with a small curved carina at middle. The female resembles the male except these impressed spaces are wanting and the antennal joints are slightly longer. 2 — 0 x 1 — mm. 3 males and 19 females Cincinnati, Ohio. The last joints of maxillary palpi of this species are long and slender and bluntly pointed at tip, differing in this respect from the other two species from here.

Symbiotes waltoni, n. sp.

Oblong oval. Color dark brown when mature. Pubescence not very dense, but conspicuous, semireclining and yellow in color. Head finely punctate. Eyes prominent. Antennæ eleven-jointed, stout, not reaching hind thoracic angles. First joint thick, longer than wide. Second slightly shorter and much narrower. Third and fourth longer than wide. Fifth, sixth and seventh about as wide as long. Eighth transverse. Ninth and tenth subquadrate. Eleventh longer and rather pointed. Prothorax one-half wider than long, with the arcuate side strongly and widely margined. Disk convex and finely punctate. Base margined and slightly sinuate each side of middle. Elytra slightly wider than prothorax, sides subparallel, with rows of large, shallow punctures in feeble striæ. Subsutural striæ punctate, not carinate as in the European *symbiotes latus*, its nearest ally. Interspaces more finely punctured than striæ. Male secondary sexual characters are a rounded, rather flat, tubercle near the tip and close to the suture of each elytron, these tubercles are very densely and finely punctate. The female resembles the male except the elytral tubercles are wanting. Length, 2 — 5 x 1 — 0 mm. Cincinnati, Ohio. Not abundant. Specimens in U. S. National Museum, Museum of Kenyon College, and my collection, where they may be examined by anyone interested.

Dedicated to Prof. L. B. Walton, who is doing such careful work on the Endomychidæ.

A NEW CYCHRUS FROM NEW MEXICO

By Charles Dury, Cincinnati, O.

Cychrus kelloggi, **n. sp.**

Color bright bronzy violet. Shining. Head long and narrow, transversely wrinkled and with a few small scattered punctures. The dilated terminal joints of all the palpi have black centers and broad borders of ivory white. Prothorax about as long as wide. Sides strongly reflexed. Side margins much thickened. More widely reflexed and thickened in front. Median line distinct its entire length. Surface of disk undulated and coarsely punctured. Apex deeply emarginate, base much less so. The basal emargination being bisinuate. Hind angles produced, not rounded at tip, nor lapping over elytra. Elytra oblong oval, about twice as long as wide. Side margins reflexed, more strongly at humeri. Fourteen equally impressed striæ with very coarse, moderately close punctures. Length, 17 mm., width, 7 mm. The specimen is a male and allied to Van Dykei, Snowi, Roeschkei, Fuchsi and Corvus, but differs from either. The anterior tarsal joints are widely dilated and jointed, 1-3 are pappillose over entire surface beneath. The antennæ are long and slender, reaching to middle of body. Sent to me by Mr. R. T. Kellogg, who was camping in Box Canyon, New Mexico, on the Upper Gila. Arising one morning after a night's rest, with the bluest of skys for a roof and the warm dry sand for a bed, in rolling up his blankets he uncovered this pretty and singular species. And though he searched for others, none were found. Type in my collection, where it may be examined by anyone interested.

VOL. XXI. No. 4

THE JOURNAL

OF THE

Cincinnati Society of Natural History

...Published May, 1914...

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IN MEMORIAM

M. H. FLETCHER, M. D.

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A NEW RHIPIDANDRUS (COLEOPTERA) FROM FLORIDA . . . . By CHARLES DURY

M. H. FLETCHER, D. D. S., M. D.

M. H. FLETCHER, D. D. S., M. D.

Mordecai Hiatt Fletcher, son of Francis Fletcher and Elizabeth Hiatt, was born at Richmond, Indiana, September 18, 1849. He was the fourth child in a family of nine children, and came of Quaker stock. He was reared on a farm which his father owned near Richmond. His love of nature seems to have been inborn. During his barefooted days on the farm, he listened to the chatter of the blackbirds as they followed up the plow. Before he was twelve he had observed the articulation of the bones of a bird's wing, and applied the mechanical principle involved to the study of aerial navigation, which he took up in the later years of his life. As a boy the only schooling he had was that afforded by the country district school in winter. He was a born investigator of natural phenomena, and love of animals, birds, insects, plants and trees oozed from every pore. Actual contact with the soil gives to a boy an enthusiasm and zest to the study of nature that is not supplied in any other way. Riley depicts the life of just such a country boy when he sings:

> "Oh! they's nothin', at morn, that's as grand unto me,
> As the glorys of Natchur so fare —
> With the Spring in the breeze, and the bloom in the trees,
> And the hum of the bees everywhere!
> The green in the woods, and the birds in the boughs,
> And the dew spangled over the fields."

At fourteen, we find Mordecai apprenticed to a jeweler in Richmond. During his apprenticeship, besides mastering the use of delicate tools, he developed constructive ability of a high order. He built two working models of a steam engine, one of which he always kept in his office and with pardonable pride exhibited to his intimates. Four years later, when he had served his time, he bought out the jewelry store in which he had learned his trade, and ran it a number of years without success. He retired from this, his only venture in the mercantile world, with this character-

istic remark: "I can not be real honest and make money in this business, for if I say an article is eighteen carats fine, it must be so if I sell it."

For some years after this he was a salesman for his brothers who were engaged in handling laces in New York City. A business career seemed to have no attractions for him, and while casting about for a calling more suited to his tastes and ambitions, someone suggested that his knowledge in the handling of fine tools which he had acquired when a jeweler's apprentice could be turned to advantage in dentistry, should he adopt that as a profession. The suggestion was followed up, and we next find him a student in dentistry in the office of Dr. J. W. Jay, at Richmond. Here he remained and received instruction until qualified to practice. In his first work done in a number of small towns within a radius of twenty miles of Richmond he was eminently successful.

Feeling the necessity of a broader training, he removed to Cincinnati and entered the Ohio College of Dental Surgery, from which he received the degree of D. D. S. in the spring of 1880. It was not his intention at this time to follow dentistry as a lifelong profession, but to use it as a means of living until he could complete a full course in medicine. Aside from the time devoted to his dental practice, he attended lectures at Miami Medical College in Cincinnati, and graduated from that institution with the degree of Doctor of Medicine in 1884.

While prosecuting his medical studies he began scientific research work in physiology and pathology. The field proved inviting to one whose mind was always bent on investigation. This collateral study along the lines of diseases of the mouth and teeth was of great advantage to him in his dental work and made the practice of dentistry in his hands a constantly advancing profession.

Thus it happened that he never practiced medicine in the ordinary acceptation of the term, but he turned to good account in dentistry all his medical learning. Being an expert mechanic, he knew how to fashion and temper steel, and whenever it was not possible to buy a tool such as he wanted, he made it.

As was to have been expected, he rose rapidly to the front ranks and long enjoyed the distinction of being one of the first men in his profession. His research work was never abandoned. In 1887 he was invited to read a paper before the Oral Surgery Section of the Ninth International Medical Congress held at Washington, D. C., on the results of his investigations during the previous seven years. During the last twenty-five years of his life the results of his research work were embodied in many papers which he read before the American Medical Association, Section of Stomatology, and the leading dental associations of the country.

At these gatherings he was recognized as an authority, and his papers received profound attention.

Of the broadest culture, there was no department of human activity that failed to enlist his interest. While his professional work engrossed him, he found time for play, but only such play as brought him mental or physical recreation. Nothing gave him greater enjoyment than an early spring day afield with his daughter, renewing his acquaintance with the birds that had just returned from the South, or later in the season with congenial spirits breasting the current of the Ohio, and living over again the joys of boyhood in the "Old Swimmin' Hole."

In 1891 he took a course in Embryology at Earlham College, and at the same time delivered a course of lecturer on Photomicrography. At the close of the course, the college, in consideration of the work which he had done along lines of scientific research, conferred on him the honorary degree of Master of Science.

In 1886 he became a member of the Cincinnati Society of Natural History. He at once took an active part in the proceedings of the Society. In 1896 he was elected to the Executive Board, and was never after that out of the councils of the Society. He filled every executive office with great credit and had all but completed a fifth term as president when death overtook him.

He was intensely interested in securing funds for a new fire proof building in which to house the Society's collection.

There was a charming geniality to his companionship that, once experienced, could not be forgotten. He died in the harness, just as he had expressed a wish that he might be taken. In the forenoon of Thursday, March 26, 1914, while at his office, he suffered a cerebral hemorrhage. In an hour he sank into unconsciousness and his spirit was released before sunset.

At the same hour two days later, as his dust was being consigned to earth in Spring Grove Cemetery, a full-throated robin poured forth in liquid tones from his innermost soul the grief of all his tribe at the loss of so rare a friend.

THE ROGERS GAP FAUNA OF CENTRAL KENTUCKY

By Aug. F. Foerste

Subdivisions of the Lexington or Trenton limestone.

In Central Kentucky, the series of strata included in the Lexington limestone long have been regarded as the approximate equivalent of the Trenton of New York. The basal part of the Lexington is composed of coarse grained limestone, forming the *Curdsville* member, and containing the fauna known from the crinoid and cystid zones of the lower Trenton in Ontario, in Canada. This is overlaid by a very fine-grained, hard limestone, interbedded with clay. On chemical analysis, this limestone proves to contain a considerable quantity of silica. It corresponds to the *Hermitage* of central Tennessee. The immediately overlying part of the Trenton consists of more or less argillaceous limestone, frequently weathering into small, irregular fragments. In this part of the section *Prasòpora simulatrix*, the "chocolate drop" bryozoan, is abundant. It forms the *Wilmore* member of the Trenton. Above the Wilmore is found a coarse-grained limestone, often forming massive outcrops, identified by Ulrich as equivalent to the *Bigby* of central Tenessee. The next part of the Trenton section consists of very fine-grained, argillaceous-appearing limestone, which, on chemical analysis, is found to be a siliceous limestone. This is the *Brachiospongia* and *Strobilospongia* horizon. At and just below this level, *Dinorthis ulrichi*, *Strophomena vicina*, and *Platystrophia colbiensis* make their first appearance. For this siliceous limestone, usually only five to ten feet thick, Prof. Arthur M. Miller has proposed the name *Brannon*. In the railroad cut south of Brannon station this siliceous limestone forms most of the cut, resting upon the top of the Bigby, containing *Stromatocerium* and *Strophomena vicina*. In the eastern part of central Kentucky, the Brannon limestone often is more or less cherty, and forms the characteristic part of the *Flanagan* chert horizon, of Marius Campbell.

The strata immediately above the Brannon member consist of coarse-grained limestone, often forming large, massive outcrops,

in which *Hebertella frankfortensis*, *Rhynchotrema increbescens*, and other fossils found also at lower horizons continue to occur. A variety of *Columnaria alveolata* is common at some horizons, especially toward the top. These coarse-grained limestones are regarded by Dr. E. O. Ulrich, in the section southwest of Frankfort, as forming the basal part of the Catheys, notwithstanding their lithological and faunal resemblance to the underlying Bigby strata, emphasis being placed upon the introduction of new fossil forms, rather than upon the retention of those already familiar at lower horizons. With this interpretation of the section, however, the term *Cynthiana* can not be synonymous with Catheys, since the base of the Cynthiana rests on the Cornishville bed, occurring much higher in the section than the top of the Brannon member. For the coarse-grained limestone overlying the Brannon member I proposed the name *Benson* limestone, in a report on the rock phosphates of central Kentucky, still unpublished. The Bigby, Brannon, and Benson limestones were included by Prof. Arthur M. Miller under his term *Paris*.

Overlying the Benson member, in the southern part of the area of outcrop of the Lexington limestone, is a coarse-grained limestone, characterized by the presence of large specimens of *Cyrtodonta grandis*. This is overlaid by finer grained limestone containing the numerous species of gasteropoda and pelecypoda, described by Ulrich as coming from the upper part of the Trenton in the vicinity of Danville and Burgin, and elsewhere in Boyle and Mercer counties. These horizons form the *Faulconer* limestone. The overlying limestone is very fine grained and hard, and of a whitish or light dove color. It is characterized by the presence of various ostracoda, among these, *Leperditia linneyi*. Lithologically the rock resembles the *Tyrone*, a formation equivalent to the Black river, and immediately underlying the Lexington limestone in central Kentucky. It has been named the *Salvisa* limestone by Prof. Arthur M. Miller. Overlying the fine-grained, dove-colored member of the Lexington limestone is its uppermost member, the *Cornishville* limestone, about five feet thick, coarse grained, and characterized by the reappearance of *Dinorthis ulrichi*, *Strophom-*

ena vicina, and *Stromatocerium* (forms found also at and immediately below the Brannon limestone), in association with *Hebertella frankfortensis* and *Rhynchotrema increbescens*, forms ranging upward from the lower part of the Wilmore, through the Bigby and Benson members, to the Cornishville limestone. To the group of strata including the Faulconer, Salvisa, and Cornishville limestones Prof. Arthur M. Miller gave the name *Perryville*, with the Salvisa limestone as its most characteristic member.

Subdivisions of the Cynthiana formation.

A. Flanagan northward to Paris, Millersburg, Carlisle, and Pleasant Valley.

Along the railroad, north of Flanagan, the Flanagan chert and the overlying coarse-grained Benson limestone is exposed. About two miles from Flanagan, on the west side of the railroad, *Allonychia flanaganensis* is very abundant in strata, which are regarded as the base of the overlying Cynthiana formation. The richly fossiliferous strata of the latter, containing *Orthorhynchula linneyi*, are exposed at numerous localities farther northward, until, at Winchester, they are overlaid by more even bedded argillaceous limestones, more frequently interbedded with clay and containing a somewhat different fauna. (For *Allonychia* see pl. II, fig. 1.)

Allonychia flanaganensis is common also three miles north of Paris, south of New Forest station, the upper part of the Benson limestone, with a possible trace of the overlying Salvisa bed, being exposed at a lower level along the pike, southwest of Myall station. Northward, toward Millersburg, this *Allonychia* horizon is overlaid by the same richly fossiliferous strata, containing *Orthorhynchula*, as north of Flanagan. In the lower part of these strata, between New Forest station and the overhead bridge two miles south of Millersburg, *Columnaria* and *Stromatocerium* are abundant locally. (For *Columnaria* see pl. IV.)

The *Orthorhynchula* fauna is abundantly exposed along the railroad also northeast of Millersburg; but, a mile from Carlisle, in a quarry west of the railroad, and south of the tunnel cut, a

mile northeast of Carlisle, specimens of *Clitambonites* occur, suggesting the presence of the overlying Rogers Gap fauna. Farther northeastward, toward Parks Hill, and, finally, south of Pleasant Valley, the *Orthorhynchula* fauna occurs again, overlaid here by a coarse-grained, massive limestone, called the *Nicholas* bed.

For the richly fossiliferous, argillaceous, irregularly bedded limestones, frequently weathering into the irregular fragments called rubble, and containing *Orthorhynchula linneyi, Hebertella parksensis, Platystrophia colbiensis, Rafinesquina winchesterensis, Cyclonema varicosum, Constellaria emaciata, Homotrypella norwoodi, Heterotrypa parvulipora*, and numerous other species, the term *Millersburg* limestone is proposed. It corresponds to the most characteristic part of the Catheys of Tennessee, and has been included in the *Greendale* division of the Cynthiana in former papers. Its base is formed by the *Allonychia* horizon, between Flanagan and Millersburg, and it is overlaid by the coarse-grained *Nicholas* limestone south of Pleasant Valley, and the coarse-grained limestone containing *Clitambonites*, south of Carlisle.

It is the Millersburg member, more than any other division of the Cynthiana formation, which contains the most frequent precursors of the Fairmount fauna, although precursors of this fauna are found also in other divisions of the Cynthiana. The richly fossiliferous exposures of the Cynthiana along the "belt line," in the northeastern part of Lexington, suggest to me the Millersburg rather than the Greendale fauna. Precursors of the Cynthiana fauna occur also in other divisions, and the Cynthiana, as a whole, may be regarded as an early introduction of the Fairmount fauna.

This *Millersburg* or *Orthorhynchula* phase of the Cynthiana formation is abundantly developed along the eastern side of the Cincinnati geanticline, as far southward as the exposures west of the Million tunnel, on the road to Valley View. Certain elements of this fauna are abundantly represented at Lexington, at the railroad cut southeast of Harrodsburg, and elsewhere southwestward. It is a remarkable fact, however, that both lithologically and faunally the strata seem to change strongly northwest-

ward of the line indicated, so that it is difficult to identify the same horizons north of Lexington, especially between Georgetown and Rogers Gap, and along the line from Cynthiana to Cincinnati, or along the Ohio river east of Ivor. The strata here are much more argillaceous and present a different faunal aspect, although the Greendale member, as developed near Lexington, is regarded as the approximate equivalent of the much more richly fossiliferous Millersburg limestone farther eastward.

B. Rogers Gap to Sadieville.

The exposures along the railroad immediately south of Rogers Gap, and from this point northward as far as Sadieville, are regarded as belonging above the horizon of the Millersburg or *Orthorhynchula* horizon. They have already furnished a number of fossils of interest to science. Among these are *Fusispira sulcata*, described by Ulrich in the third volume of the Minnesota Geological Survey; *Heterotrypa foerstei*, described by Nickles in Bulletin 5 of the Kentucky Geological Survey; and *Eridorthis rogersensis*, *Eridorthis nicklesi*, and *Clitambonites rogersensis*, described in volume Fourteen of the Bulletin of Denison University. To this list must be added *Strophomena higginsportensis*, described in volume Seventeen of this Bulletin from strata along the Ohio river, now known also from the exposures north of Rogers Gap. This Rogers Gap Fauna is, in many respects, peculiar, including species not found at any other horizon. This fauna forms the object of special study on the following pages. The typical exposures, extending along the railroad from the cut immediately south of Rogers Gap to that north of the bridge north of Sadieville, have been selected. An account of the relationship of the various strata here exposed follows.

Immediately south of the railroad station at Rogers Gap, there is exposed, a short distance above track level, a coarse-grained, massive limestone, above which lies the typical Rogers Gap fauna as found in the railroad cut farther southward. A third of a mile north of Rogers Gap this massive coarse-grained limestone is exposed again, west of the track, below railroad level. It is seen

also at the base of the cut 59.1 miles south of Ludlow, or one mile north of Rogers Gap. This coarse-grained limestone may correspond to the coarse-grained rock containing *Clitambonites* in the vicinity of Carlisle.

At the railroad cut 59.1, one mile north of Rogers Gap, the coarse-grained limestone is immediately overlaid by argillaceous strata in which *Eridorthis rogersensis* and *Eridorthis nicklesi* are fairly common; this is the horizon also for *Clitambonites rogersensis*, but the latter is far less common. *Hebertella latasulcata* is rare. A poorly outlined specimen, which occurred at the same level, may have been an *Orthorhynchula.*

Eight feet above the coarse-grained basal layer, *Strophomena higginsportensis* was found. At about this same horizon *Platystrophia colbiensis* and the Rogers Gap form of *Dalmanella* occur. The immediately overlying strata contain *Perenopora vera, Heterotrypa foerstei, Cyclonema varicosum-cincinnatiense*, and *Orthoceras rogersensis.* At a still higher horizon, in the upper part of this railroad cut 59.1, *Bellerophon rogersensis, Tetranota obsoleta, Liospira vitruvia*, and a small unknown *Lophospira*, described on the later pages of this paper, are common. This gasteropoda horizon is quite constant in the area between Rogers Gap and Sadieville, and is useful in correlating the different sections. At about the same elevation, or immediately above, the following species occur: *Ectenocrinus grandis, Constellaria emaciata, Lingula* cf. *cincinnatiensis, Hormotoma terebriformis, Hormotoma gracilis-sublaxa, Holopea incerta, Byssonychia vera, Modiolopsis rogersensis*, a species of *Orthodesma* belonging to the *subnasutum* group, and another belonging to the *nasutum* group, *Lyrodesma subplanum, Orthoceras rogersensis, Isotelus benjamini*, and a species of *Calymene.* Near the top of the railroad cut *Conularia trentonensis-rogersensis* and *Eridorthis rogersensis* were collected. Farther south the following species were collected at about the same horizons as those exposed at the railroad cut 59.1, one mile north of Rogers Gap: *Crepipora venusta, Lichenocrinus subaequalis, Strophomena hallie, Byssonychia byrnesi*, and *Fusispira sulcata. Strophomena hallie* is very rare at these lower hori-

zons, although very common in the higher zones between Rogers Gap and Sadieville, where *Plectambonites* is very common. *Hebertella latasulcata* is another one of the species which occurs occasionally at lower levels, but which is common only in the upper zones, in which *Plectambonites* is common. The striking feature about this locality 59.1, one mile north of Rogers Gap, is the fact that, for a vertical distance of 33 feet above the basal, coarse-grained limestone, *Plectambonites* is present, but never abundant. It is abundant only at the higher horizons, discussed later.

Farther northward, at 58.9 miles south of Ludlow, the coarse-grained basal limestone is exposed a short distance below track level. Only about two and a half feet are seen, but there may be more layers of the same kind at a lower level. The overlying strata, corresponding to those at 59.1, contain *Constellaria emaciata*, a form with a poorly preserved cardinal margin, which may be an *Orthorhynchula*, *Zygospira recurvirostra*, *Cyclonema varicosum-cincinnatiense*, and *Modiolopsis rogersensis*.

At the next cut northward, 58.8 miles south of Ludlow, the basal coarse-grained limestone has thinned out, and the rock most nearly approaching it in horizon presents quite a different lithological appearance. Twenty feet farther up there are several layers of coarse-grained limestone, totalling a thickness of six feet; in these coarse-grained limestones *Eridorthis nicklesi* and *Cyclonema varicosum-cincinnatiensis* occur. The striking feature about this upper coarse-grained limestone horizon, associated with *Eridorthis*, is the fact that three and a half feet higher *Plectambonites* is common. *Plectambonites* is not common over the lower basal, coarse-grained limestone layer.

The upper coarse-grained limestone containing *Eridorthis* is exposed again farther northward, at 58.6. Three and a half feet above this limestone *Plectambonites* is abundant. One foot farther up there is a coarse-grained limestone layer, nine inches thick, also containing *Eridorthis*. In the overlying thinner bedded strata *Plectambonites* is abundant, associated with occasional specimens of *Strophomena hallie*.

The upper coarse-grained limestone horizon, associated with *Eridorthis*, may be distinguished from the basal coarse-grained layer most readily by the fact that *Plectambonites* is very abundant in the strata overlying the upper horizon while occurring only sparingly above the basal layer. Moreover, the gasteropod horizon, with *Bellerophon rogersensis*, *Tetranota obsoleta*, *Liospira vitruvia*, and the unknown *Lophospira*, occurs between the two coarse-grained limestone horizons, not above the upper one. Finally, *Eridorthis* is most common immediately above the basal, coarse-grained limestone, but immediately below the upper coarse-grained horizon.

For a considerable distance north of the last described locality, between 58.5 and 55.7, only the strata above the coarse-grained limestone are exposed above railroad level. In these strata *Plectambonites* is abundant, and certain species appear which have not been noted at lower levels. Among these are *Diplograptus* (*Mesograptus*) *putillus-eximius*, and *Trinucleus concentricus*. *Strophomena hallie* and *Hebertella latasulcata* are much more common than at lower levels. *Pterinea demissa* is seen occasionally. *Perenopora vera* is abundant. *Byssonychia vera* is not rare. *Ectenocrinus grandis*, *Cyclonema varicosum-cincinnatiensis*, *Hormotoma terebriformis*, *Dalmanites* cf. *achates*, and *Proetus* are rare.

A mile and a half south of Sadieville, at 55.6 miles south of Ludlow, a country road passes beneath the railroad. At the level of the country road, the basal, coarse-grained limestone contains *Hebertella*, *Platystrophia*, and *Cyclonema*. The coarse-grained limestone here is of considerable thickness, a vertical height of 18 feet being exposed above road level, *Hebertella* being present, even at the top. Five and a half feet higher, gasteropods of the type found in the gasteropod layer, between the two coarse-grained limestone horizons, at locality 59.1, are common. Fossils in general are not abundant until a level about 20 feet above the basal, coarse-grained limestone is reached. The layers with *Plectambonites* common are not seen until a level 43 feet above the basal, coarse-grained limestone is attained. Here it immediately over-

lies the upper crinoidal limestone, whose exact thickness is not exposed, although it is known to equal several feet.

The upper coarse-grained limestone horizon is exposed also at the cut south of 55.4. At the cut north of 55.4, *Plectambonites* becomes common eight feet above railroad level. At 55.3 the upper coarse-grained limestone is overlaid by strata containing *Perenopora vera*, *Strophomena hallie*, and *Trinucleus* in strata in which *Plectambonites* is common. At 55.25, the upper, massive, coarse-grained limestone is 8 feet thick, and is overlaid by strata in which *Plectambonites* is common. Several specimens of *Eridorthis* and of *Clitambonites* occur two feet above the base. At 55.1 the top of the upper coarse-grained limestone is down to track level. At 55.0 the overlying strata contain *Perenopora vera*, *Hebertella latasulcata*, *Strophomena hallie*, *Byssonychia vera*, and *Modiolopsis rogersensis*, in addition to an abundance of *Plectambonites*. At 54.9 the upper coarse-grained limestone remains below track level. At 54.8, the overlying strata, in addition to the species already named, contain also *Trinucleus*.

In the cut extending from 54.7 to 54.6, *Eridorthis* occurs six feet above track level, but is common only at the horizon between one and two feet above the railroad, in strata which belong below the horizon of the upper coarse-grained limestone. *Cyclonema varicosum-cincinnatiensis* occurs at this upper *Eridorthis* horizon. In the strata above the upper coarse-grained limestone *Plectambonites* is common, and free cheeks of *Acidaspis* and a large *Lingula* occur.

At the southern end of cut 54.3, the following species are found between a level four feet above the track and the base of the cut: *Eridorthis rogersensis* and *nicklesi*, *Clitambonites rogersensis*, *Platystrophia colbiensis*, *Bellerophon rogersensis*, and *Modiolopsis rogersensis*. *Strophomena hallie*, *Strophomena higginsportensis*, and *Clathrospira subconica* occur at the top of the cut, associated with *Ceratopsis chambersi* and occasional specimens of *Eridorthis*. At 54.2 the top of the upper massive, coarse-grained limestone is seven and a half feet above the railroad track, and

is overlaid by strata in which *Plectambonites* is abundant. Both *Crepipora venusta* and several specimens of *Eridorthis* were secured near the top of the cut. *Hebertella latasulcata* and *Strophomena hallie* are present. The basal coarse-grained limestone horizon is not exposed above track level in this vicinity. The railroad bridge crossing the pike in the southern part of Sadieville is marked 54.0 miles south of Ludlow.

Although it has been possible to establish two *Eridorthis* horizons, associated with two coarse-grained limestone horizons, in the areas between Rogers Gap and Sadieville, the lithological changes, even within this short distance of six miles, are sufficient to suggest that, within comparatively short distances, strata essentially equivalent to the Rogers Gap beds may show a somewhat different succession of faunal zones.

C. Riverside station.

Eridorthis is known also from Riverside station, one mile north of Ford, in Clark County, Kentucky. Directly opposite the station, *Eridorthis nicklesi* was found at track level, associated with *Bellerophon rogersensis*. One foot above this horizon, but farther westward, *Eridorthis* was seen in the same rock fragment with *Perenopora vera*, the Rogers Gap form of *Dalmanella*, *Hebertella latasulcata*, *Platystrophia colbiensis*, and *Hormotoma gracilis-sublaxa*. The highest known range for *Eridorthis* at this locality is stratigraphically two feet above the railroad track at Riverside station. Between two and four feet above this highest *Eridorthis* horizon, *Rafinesquina* is very abundant. In the overlying layers *Strophomena hallie*, *Hebertella latasulcata*, and *Cyclonema varicosum-cincinnatense* occur. These layers are regarded as corresponding approximately to the layers above the upper coarse-grained limestone, full of *Plectambonites*, between Rogers Gap and Sadieville. *Clitambonites rogersensis* occurs at Riverside eight feet below the level of the station, stratigraphically, but farther southward, owing to the northward dip of the strata. The best locality is near the first railroad switch. Directly beneath the *Clitambonites* horizon, *Platystrophia colbiensis* is common. Specimens

resembling *Hebertella parksensis* and *Rafinesquina winchesterensis* occur associated with *Platystrophia colbiensis, Cyclonema varicosum-cincinnatense*, and a form resembling *Orthorhynchula,* but with the cardinal margin not well preserved, all within six feet of the base of the *Clitambonites* horizon.

Farther southward there appears to have been a fault, and at the first switch north of the tunnel, south of Riverside, *Trinucleus* occurs a short distance above track level.

D. Cincinnati eastward to Ivor and Carnestown.

Traces of the Rogers Gap fauna are found also along the Ohio River, at various points east of Cincinnati—including Brent, Ninemile creek, and Ivor. Here its horizon is below the strata exposed at West Covington, opposite Cincinnati, and above strata regarded as equivalent to the Millersburg or *Orthorhynchula* division of the Cynthiana formation.

At West Covington, a coarse-grained crinoidal limestone layer, two feet thick, occurred fifty feet above former low water, before the dam was built below Cincinnati. Immediately above this crinoidal limestone belongs the *Fulton* or *Triarthrus* clay shale, well exposed at various localities east of Cincinnati. This Fulton layer forms the base of the *Eden* formation.

Immediately below the crinoidal layer, at West Covington, for a distance of about 25 feet, limestone is frequently interbedded with clay shale for a vertical distance of 25 feet. The underlying strata are chiefly shaly and form the *Bromley* member of the Cynthiana formation. The overlying strata, in which interbedded limestones are frequent, form the upper and best exposed part of the *Point Pleasant* member, as exposed at the type locality, twenty miles southeast of Cincinnati.

About half a mile west of Brent, a short distance east of the old waterworks station, directly north of Fort Thomas, I once found *Eridorthis* in layers of rock near the river level, immediately over clayey strata in which argillaceous nodules were rather common. At present this horizon is covered by water, owing to

the dam recently erected a number of miles below Cincinnati. The overlying strata correspond to the upper part of the Point Pleasant beds, beneath the Fulton layer, as exposed at West Covington. *Eridorthis* occurs at a similar horizon also on the Ohio side of the river, along the lower part of Nine-mile creek.

About three miles southeast of Point Pleasant, on the Kentucky side of the river, at the quarry east of Ivor, there is a granular limestone layer several feet thick, the top of which is 73 feet above the railroad. It is overlaid by several feet of clay shale, and then by a considerable thickness of fossiliferous, interbedded thin limestone and shale. In the upper part of this granular limestone I once found a specimen of *Eridorthis*. At the track level, in the same quarry, a specimen of *Orthorhynchula* was collected. Fifty feet below track level, *Dalmanella bassleri* and *Callopora multitabulata* are common at the river landing.

In the creek bed of Carnestown, a short distance east of Ivor, the top of this *Callopora multitabulata* horizon contains a *Prasopora* resembling *P. simulatrix*, specimens resembling *Prasopora falesi, Eridotrypa mutabilis, Eridotrypa trentonensis, Plectambonites* cf. *curdsvillensis, Dalmanella bassleri, Platystrophia colbiensis, Strophomena vicina*, and *Zygospira recurvirostra*. Judging from the sections in Central Kentucky, this fauna belongs directly below the horizon of the Brannon, the most characteristic member of the Flanagan. No equivalent to the Brannon bed is found at Carnestown. A rounded specimen of *Prasopora simulatrix* was found by Dr. R. S. Bassler, imbedded like a pebble in the base of the overlying Bigby. The *Orthorhynchula* horizon, at the railroad level, is regarded as approximately contemporaneous with the Millersburg division of the Cynthiana. The *Eridorthis* horizon is correlated with the Rogers Gap beds. The Fulton layer belongs considerably higher, as indicated by the exposures at Brent.

E. Cynthiana.

The term *Cynthiana* formation was introduced to include all strata between the top of the Lexington, as here defined, and the base of the Eden formation; in other words, between the top of the

Cornishville limestone and the base of the Fulton layer. The name Cynthiana was chosen because this formation appeared to present strong lithological and faunal changes on being traced from the line of exposures including Flanagan, Winchester, Paris, Millersburg, Carlisle, and Pleasant Valley, westward across the axis of the Cincinnati geanticline; because the town represented a sort of intermediate area between the eastern and western phases of this formation; and because it was one of the most northern points at which the exact contact between the top of the Lexington and the base of the Cynthiana formation could be seen. The character of the base of the Cynthiana formation here, however, is quite different from that seen north of Flanagan and north of Paris. There is no horizon at which *Allonychia flanaganensis* is abundant. There is no abundance of *Orthorhynchula* nor any typical development of the Millersburg fauna.

The exposures at Cynthiana occur along the railroad, one mile north of the station, where the railroad approaches the river. Here massive, coarse-grained limestone, corresponding to the Benson member is exposed above river level for a height of 19 feet. The lower part of the limestone is cross-bedded, and *Rhynchotrema increbescens*, *Dalmanella* sp., and *Hebertella frankfortensis* is common also 11 feet above river level. Overlying the massive, coarse-grained Benson limestone are more argillaceous limestones interbedded with softer layers, weathering into alternations of comparatively thin-bedded limestone and clay. That part of this argillaceous section which lies below railroad level is poorly exposed for fossil collecting, but the overlying parts have been quarried sufficiently west of the railroad to provide a considerable fauna. The strata bear a lithological resemblance to those at Rogers Gap, but no specimens of *Eridorthis*, *Clitambonites* or even of *Plectambonites* or *Trinucleus* were found. Moreover, the *Cyclomena* seen here is taller and more like typical *C. varicosum*. On the other hand, species of *Constellaria*, *Perenopora*, *Dalmanella*, *Hebertella*, *Platystrophia*, *Byssonychia*, *Liospira*, *Isotelus*, *Calymene*, and *Proetus*, resembling those found in the Rogers Gap beds, occur. For the present, these beds are regarded as belonging below the Millersburg member.

In the quarry within the northern limits of Cynthiana, directly west of the railroad, I collected *Strophomena vicina* from limestone boulders freshly broken out of the quarry, and stated by the quarrymen to have come from the lower part of the quarry. This *Strophomena vicina* horizon is regarded as corresponding to the zone immediately below the Brannon member of the Flanagan.

THE ROGERS GAP FAUNA, WITH A DESCRIPTION OF A FEW MILLERSBURG AND BENSON LIMESTONE SPECIES.

On the following pages, descriptive of the fauna of the Rogers Gap beds between Rogers Gap and Sadieville, the locality numbers refer to the numerous marks recently put up by the railroad to indicate the location of cuts, gullies and bridges, and their distance from the first station in Ludlow, Kentucky, opposite Cincinnati. Remembering that the 60-mile mark is immediately north of Rogers Gap, and that the 54-mile mark is within the northern limits of Sadieville, the location of the various exposures may be readily determined.

1 — *Columnaria alveolata — interventa*, var. nov. (Plate IV, Figs. 1 A-J) — In the Benson member of the Lexington limestone, in Central Kentucky, a variety of *Columnaria alveolata* is very abundant. The type of this species was obtained from the vicinity of Seneca Lake in Central New York, and evidently was an erratic specimen. It is not known from the Trenton or Lorraine of New York, and apparently must have come from some Canadian source. Without seeing the type, it is scarcely worth while to speculate as to its original horizon and geographical position, although it usually is assumed that it was a Richmond form of Canadian origin. The variety found in the Benson limestone is abundant locally in Central Kentucky. Its chief characteristic consists in the very unequal size of the corallites, some of the corallites growing to large size, while the surrounding ones are much smaller. This feature is shown best by Figs. 1A, 1B, although close inspection will show similar features in Figs. 1D and 1G. This feature is shown best by the smaller coralla with the more rapidly diverging corallites, as in Fig. 1C. In the larger

sized coralla, as in 1E, the difference in the size of the corallites often is less striking. The vertical corrugation of the walls of the corallites, corresponding to the position of the septa, is shown by Figs. 1C, 1F. The septa are best indicated in Fig. 1E. The base of the corallum was covered by an epithecal layer. In the specimen represented by Fig. 1H the epithecal layer was flat, as though tightly pressed against some smooth surface. The base of the initial corallite is seen at the center of the radiating corallites, and from this initial corallite others branched off, first toward the right and later toward the left, viewing the corallum in the position indicated in the figure. In Fig. 1J the initial corallite is seen directed from the center diagonally upward and toward the right. From this initial corallite the others branched off at first on the upper side of the corallum, as here figured, and later on the lower side. The base of the corallum in this case was not appressed to a flat surface, but grew freely, so that the corallites on the lower surface of the corallum show semi-cylindrical surfaces, while at their contacts with each other they show the flattened prismatic faces due to crowding. The epithecal layer in this case evidently followed the semi-cylindrical free faces of the individual corallites, and therefore did not present a flattened surface as in Fig. 1H. A considerable collection of specimens showing these lower surfaces was made at one time at the long exposures at stop 11, north of Hulitt station, northeast of Brannon, along the traction road from Lexington to Nicholasville. The Benson limestone here was weathered to clay, overlying, at the base of the cut, the Brannon argillaceous limestone.

Compared with these Trenton specimens, those from the Millersburg member of the Cynthiana formation, between New Forest station and the overhead bridge two miles south of Millersburg, show larger coralla but smaller corallites. Corallites 5 mm. in diameter are relatively very large in these Millersburg specimens, while their average diameter is nearer 3 mm. They form the variety *Columnaria alveolata-minima*.

Columnaria, of the *alveolata* type, makes its first appearance in the upper part of the Black river limestone, at Ottawa and also

on Cloche Island, in Ontario, Canada. In these Black river forms the corallites are very large, often reaching a diameter of 7 mm., and have a tendency to be discrete, with rounded corallites. For these the term *Columnaria alveolata-discreta* will prove convenient.

2 — *Diplograptus* cf. *putillus* — A species belonging to the group of *Diplograptus* (*Mesograptus*) *putillus*, Hall, occurs at the railroad cuts 58.5, 58.3, 57.6, 57.4, and 56.4 miles from Ludlow. Dr. Ruedemann cites this fossil from the lower third of the Eden at Cincinnati Ohio, and Nickles gives its range as through the Eden. Dr. Ruedemann calls my attention to the fact that the Rogers Gap specimens approach nearest in size to the mutation *eximius*, occurring in the Canajoharie and Snake Hill beds of the Trenton section in New York, and suggests the probability of several species being hidden under the name *putillus*. *Diplograptus putillus* and the mutation *eximius* are illustrated in Part 2 of Ruedemann's memoir on the Graptolites of New York, published by the New York State Museum in 1908.

3 — *Ectenocrinus grandis*, Meek (Plate I, Figs. 8A, B, C, D) —A species intermediate in size between *Ectenocrinus simplex* and *E. grandis* occurs at the railroad cut south of Rogers Gap, and also northward, at 59.4, 59.1, 58.5 and 54.5 miles from Ludlow. While probably not of the same species, I can find no means of distinguishing the Rogers Gap species from *E. grandis*, except its slightly smaller size. Both *E. simplex* and *E. grandis* are characteristic Eden forms, in the vicinity of Cincinnati. Perhaps, on that account, the comparison should have been made with *Ectenocrinus canadensis*, Billings, from the Trenton of Ottawa and Montreal, which is closely similar to *E. grandis*. Owing to the presence of syzygies in the arms of this genus, all of the species have more or less irregularities in the number of post-radial plates — two often being replaced by one of about the same size as the two combined. Such syzygies are common in the Rogers Gap specimens, not only in the brachial but also in the radial series. The column diminishes rapidly in size, from 3.5 mm. at the base of the calyx to 1.8 mm. within a distance of 1mm. At a distance of 25 mm. it still has a diameter of 1.8 mm. At the base of the

calyx (Fig. 8C), it is marked by numerous close transverse lines of equal size and not readily noticed except under a lens. At 20 mm. from the calyx certain of these lines at more or less equal intervals are very slightly more prominent, and even at 30 mm. this prominence remains slight. Gradually, however, they become more prominent until they are readily seen by the unaided eye. At a distance of 50 to 80 mm. (Fig. 8D), the small diameter of the stem remains, and, among the more prominent transverse striæ, an alternation of stronger and weaker striæ is noticed, in the interval between which are the still finer striæ, such as are found along the upper end of the stem. Finally, the prominent transverse lines widen as well as increase in height, and a series of alternating larger and smaller "beads" results, which give rise to the columnals.

4 — *Ohiocrinus exilis*, sp. nov. (Plate I, Fig. 7) — At the railroad cut 59.1 miles from Ludlow, a form of *Ohiocrinus*, regarded by Mr. Frank Springer as essentially identical with *Ohiocrinus laxus*, from the Fairmount division of the Maysville, was found, which may prove to be a distinct species. Syzygies are present both among the brachials and the radials, but no special significance is attached to this fact. The dorsal side of both radials and brachials, however, is strongly convex, leaving distinct intermediate grooves. The base is broken off. The heterotomy of the arms is not detected as readily as in typical specimens of *Ohiocrinus laxus*.

5 — *Lichenocrinus subaequalis*, sp. nov. (Plate I, Fig. 10) — Two specimens occur, in contact with each other, on the same rock fragment, obtained at the railroad cut 59.8 miles from Ludlow. They consist of the basal attachment disc of some crinoidal organism, and one of the specimens retains the basal part of the peculiarly jointed column. The heads of one of the Cincinnatian species of *Lichenocrinus* have been known for some time, and Mr. Frank Springer has in his possession a head which promises to give some insight into the relationship of this peculiar genus.

The attachment disc of the Rogers Gap form is about 6 mm. wide and a little over a millimeter in height, the downward slope

at the margin being quite abrupt. The central part, around the base of the column, is depressed, so that the remainder may be described as a sort of moderately elevated ring. The plates along the crest of this ring are separated by two, sometimes three plates of smaller size from the central column, as in *Lichenocrinus crateriformis*, from the Eden beds at Cincinnati, but the plates along the crest are relatively not as large nor as regularly arranged as in that species. The greatest specific difference, however, is presented by the plates lying between those along the crest of the ring and the basal margin. Of these there may roughly be said to be about two sets, although as a matter of fact all of the plates of this attachment base are quite irregularly arranged. Both of the sets of plates just mentioned are approximately of the same size as those along the crest, differing in this respect conspicuously from *Lichenocrinus crateriformis*. There is no regular series of plates along the crest of the ring, but keeping as nearly along a continuous line as possible, about twenty plates may be said to form this line. The average diameter of the larger plates is about three-quarters of a millimeter, although single plates a millimeter in diameter occur. No ornamentation of the plates was noted.

6 — *Constellaria emaciata*, Ulrich and Bassler. (Plate I, Fig. 1) — Specimens resembling this species occur in the cut south of Rogers Gap, within 15 feet above the station, also in the railroad cuts 59.1 and 58.9 miles from Ludlow. The species is characteristic of the Greendale division of the Catheys. No species of *Constellaria* has been cited so far from the Economy or Southgate divisions of the Eden at Cincinnati.

7 — *Crepipora venusta*, Ulrich. This species is found at Rogers Gap within 15 feet above the level of the railroad station; also at various localities northward, but only the record of its occurrence at the railroad cut 54.2 miles from Ludlow is preserved. The species was described from the lower or Economy division of the Eden, but closely similar forms are known to occur along the Ohio river in strata below the level of the Fulton bed.

8 — *Heterotrypa foerstei*, Nickles. This species occurs at various localities near Rogers Gap and Sadieville, but only the record

of its existence at 59.1 from Ludlow is preserved. Here it is very common, and this probably was the type locality. No species of *Heterotrypa* is known from the Economy or Southgate divisions of the Eden at Cincinnati, if the validity of the genus *Dekayella* is maintained.

9 — *Perenopora vera*, Ulrich. A *Perenopora* of large size is abundant at many localities near Rogers Gap, including those at 59.1 and 58.8 miles from Ludlow. It occurs at all localities between 58.3 and Sadieville. *Perenopora vera* is an Eden and lower Maysville form. The forms below the Fulton layer may belong to a different species. *Perenopora milleri* was described by Nickles from the Greendale bed along an abandoned railroad belt line in the northeastern part of Lexington, Kentucky.

Monotrypa subglobosa, Ulrich, *Escharopora falciformis*, Nicholson, and *Arthropora cleavelandi*, James, were identified from the strata at Rogers Gap before it was known that these strata belong stratigraphically below the Eden formation. Since they all are Eden forms, it is necessary that the forms thus identified from the Rogers Gap beds be subjected to further study. In the meantime, it is evident that forms at least closely related to these species exist also in the lower beds, as exposed at Rogers Gap.

10 — *Lingula* cf. *cincinnatiensis*, Hall and Whitfield (Plate II, Figs. 2, 3). The brachial valve of *Lingula cincinnatiensis* is characterized by four slightly convex cuneiform concrete lateral scars. The anterior part of the middle pair may correspond to the central scars of other species. The outer pair is narrower and less distinctly defined laterally. The median septum extends beyond the central scars to within two-fifths the length of the shell from the anterior margin, becoming high and sharply angular on top. A fragment of a shell, evidently belonging to the same section of the genus, was found at the railroad cut 59.1 miles south of Ludlow. Enough remains to show the presence of a very strong median septum, about a millimeter in height, terminating abruptly 5 mm. in front of the deeply impressed central scars. The thickness from valve to valve is 6 mm., and the width 20 mm. The shell is whitish, pearly, and concentrically striated. The concentric striæ are more

numerous on the inner layers of the shell, and here, also, the radiating striations, obscure or obsolete on the surface, are distinct. Fig. 2 represents the typical form from the Fairmount at Cincinnati. Fig. 3 is the Rogers Gap specimen.

Shells of the *cincinnatiensis* type begin their range in the Trenton of New York, from which they were identified by Hall as *Lingula quadrata*, an incorrect determination. In the specimen figured in Dana's Manual (p. 507, Fig. 667), the outer shell layer is black, and concentrically striated. The inner shell layer is white, and marked by numerous radiating lines, especialy along the middle part of the shell. The concrete laterals are gently convex as in *Lingula cincinnatiensis*. The anterior margin is rounded rather than quadrate. *Lingula rectilateralis*, Emmons, was figured among a group of fossils regarded as of Utica age because associated with *Triarthrus*. Of this group of "Utica" fossils, probably only *Avicula insueta* was figured from the Mohawk valley. Hall figured as *Lingula rectilateralis* a specimen from the vicinity of Lorraine. The anterior margin is rounded rather than quadrate. Radiating striæ are distinct along the middle part of the shell, becoming finer beyond lines drawn from the beak to the antero-lateral margins. Apparently there was a strong median septum, anterior to cuneiform concrete laterals, the anterior part of the inner pair corresponding to the central scars, as in *Lingula cincinnatiensis*, but the curvature of these concrete lateral scars appears to have been concave, the shell being very thin. *Lingula iowaensis*, Owen, from the Maquoketa of the Northwest, also is figured as having concave concrete laterals, but in all other respects resembles *Lingula cincinnatiensis*, although usually figured as having a more quadrate outline. This group of shells is so closely related that it will require an abundance of specimens to discriminate the different species. *Lingula cincinnatiensis* was described from the Fairmount member of the Maysville at Cincinnati, Ohio.

11 — *Lingula whitfieldi*, Ulrich. (Plate II. Fig. 8.) — A broadly oval brachial valve, 21 mm. in length and 17 mm. in width, agreeing in outline with the published figure of *Lingula whitfieldi*, was

found at the railroad cut 57.5 miles from Ludlow. A second specimen, more acute toward the beak, possibly a pedicel valve of the same species, was found at 54.7. The thickness of the shell from valve to valve was about 4.5 mm. The exterior is concentrically marked. *Lingula whitfieldi* was described from strata beneath the Fulton layer, a few feet above low water, at Covington, opposite Cincinnati.

12 — *Lingula* cf. *procteri*, Ulrich. (Plate II, Fig. 7.) — A brachial valve, 20 mm. long and 14 mm. wide, resembling *Lingula procteri* in outline, was found at the railroad cut 55.8 miles from Ludlow. Specimens which may belong to the same species occur in the railroad cut one mile north of the railroad station at Cynthiana. In these the interior of the pedicel valve agrees fairly well with that figured by Hall and Clarke (Paleontology of New York, Vol. 8). There is the same broad, flat septal linear area separating the cuneiform concrete laterals. The striæ in front of the flat septal area, however, are straight for a considerable distance forward, and from this median area, as well as from the anterior part of the concrete laterals, the other striæ diverge. The interior of the brachial valve bears only a moderate resemblance to the figures published by Ulrich and by Hall and Clarke. There is a broad, flat, median septal area, fairly well outlined, as in the case of the pedicel valve. On each side of this septal area is a concrete lateral, convexly rounded antero-laterally, as in the figure published by Hall and Clarke. The anterior part of the concrete laterals is slightly more deeply impressed, and may correspond to the centrals, as in the *Lingula cincinnatiensis* group. Anterior to this part of the concrete laterals, the flat, median septal area is prolonged as a somewhat narrower but more convex and more prominent septum, narrowing in front and almost reaching the anterior margin. This anterior septum, and that part of the concrete lateral which may correspond to the centrals, are bordered laterally by a narrow, shallow groove, outlining an area somewhat similar to that figured by Ulrich. Between this groove and the lateral margins there are two areas of vascular markings, separated by a narrow, flat, smooth area, somewhat similar to

those figured by Whitfield in the case of his species, *Lingula Elderi*. *Lingula procteri* was described as ranging from the middle Trenton in Central Kentucky, to 50 feet above low water at Covington. The latter includes the strata immediately below the Fulton layer opposite Cincinnati.

13 — *Strophomena higginsportensis*. Foerste (Plate I, Fig. 9) — Whatever the form may be to which the term *Strophomena higginsportensis* has been applied, this much progress, at least, has been made — it is now known to belong to the Rogers Gap fauna. Along the Ohio river it was always found loose. At the large quarry east of Ivor, along the Ohio river, in Pendleton county, it has been found impossible to identify the Fulton bed, with its *Triarthrus*, probably because it is not present, or is represented by lithologically different strata. However, a layer of clay, about 5 feet thick, occurs 73 feet above the level of the railroad. In the immediately underlying strata I once found a specimen of *Eridorthis*, since lost. It probably is from this part of the section, or at least some neighboring part, that the specimens of *Strophomena higginsportensis* were obtained. It is significant, in this connection, to note that at this Ivor quarry a single specimen of *Orthorhynchula linneyi* was found at track level, at the base of the quarry. The 5-foot clay layer, overlying the *Eridorthis* horizon, may not be the Fulton layer, since the strata above this clay layer contain a fauna quite different from the typical lower Economy. One specimen of *Str. higginsportensis* was found at 59.1, and another at 54.3 miles from Ludlow.

14 — *Strophomena hallie*, Miller (Plate II, Figs. 5A, B) — Characteristic specimens of this Eden species, both exteriors and interiors, are found at various localities north of Rogers Gap. Their presence has been noted at 59.7, 58.7, 58.5, 58.3, 57.4, 55.7, 55.3, 55.0, 54.8, 54.3, and 54.2 miles from Ludlow. The species is very rare below the upper *Eridorthis* horizon, though fairly common at some horizons above this level.

As already noted in my paper on *Strophomena*, *Strophomena hallie* is regarded as a precursor of *Strophomena maysvillensis*, of

which *Strophomena planoconvexa*, although described earlier, is only a weaker, less vigorous form.

15 — *Hebertella latasulcata*, sp. nov. (Plate III, Figs. 7A, B; exterior and interior of pedicel valve.) — Shell attaining a length of 26 mm. and a width of 35 mm., though usually only about 30 mm. in width. The median part of the brachial valve often is elevated along the anterior half of the shell into a fairly prominent fold. The valve, in general, is quite strongly convex, and the beak is quite strongly incurved. The most striking external feature is shown by the pedicel valve. This is comparatively flat, does not have a high cardinal area, and, hence, does not have a prominent beak. The latter is moderately incurved. The median sinus or depression is remarkably wide and shallow except close to the anterior margin, where it adjoins the fold of the brachial valve. The radiating plications are rather numerous, with only a moderate tendency toward grouping into fascicles on the pedicel valve, and even less on the brachial valve. Cardinal and crural plates of the brachial valve sharp and thin; muscular markings very faint or obsolete. The muscular area of the pedicel valve tends to be narrower, especially anteriorly, and hence has a less cordate outline than the more typical forms of *Hebertella occidentalis* and *H. sinuata*. The muscular area, moreover, is less deeply impressed, especially anteriorly. Specimens of this type occur in the cut south of Rogers Gap and at 59.3, 58.5, 58.3; are typically developed at 58.1; and occur also at 57.8, 57.6, 57.4, 56.8, 56.4, 55.7, 55.0, and 54.2. It is not a strongly defined species, but belongs to the series recently called, by some paleontologists, mutations. The absence of *Hebertella* in the Eden at Cincinnati should here be noted.

16 — *Platystrophia* cf. *colbiensis*, Foerste — A small form of *Platystrophia*, resembling *Platystrophia colbiensis*, occurs at 59.1, 54.5, and 54.3 miles from Ludlow. It usually does not exceed 15 mm. in length, and is associated with occasional specimens, having a very short hingeline, which eventually may turn out to be an *Orthorhynchula*, but sufficiently good specimens to admit of accurate determination have not been found as yet. Illustrations

of *Platystrophia colbiensis* are given in the Denison University Bulletin, vol. XVI, plate IV. *Orthorhynchula linneyi* is figured on plate III.

17 — *Eridorthis* — *Eridorthis nicklesi*, Foerste (Plate I, Figs. 5A, B, C), was identified at 60.3, 59.1, 54.5, and 54.3 miles from Ludlow. *Eridorthis rogersensis* was identified from 60.3, 59.7, 59.5, 59.1, 55.3, 54.5, 54.3, and 54.2, but is the less common form. One of these two species of *Eridorthis*, but not further identified, is present also at 58.8, 58.7, and 54.8. The occurrence of this form at Riverside, north of Ford, and along the Ohio river at Brent, Nine-mile creek, and Ivor has already been noted. It occurs also near Hutchison station, on the railroad from Lexington to Winchester.

18 — *Clitambonites rogersensis*, Foerste (Plate II, Figs. 6A, B, C, D) — This species occurs at the railroad cut south of Rogers Gap, and also northwards at the cuts 59.1, 55.3, 54.8, and 54.3 miles from Ludlow. It is found also at Riverside, the station one mile north of Ford, at the same stratigraphic horizon. No species of *Clitambonites* is known from the Eden or Maysville, of the areas at or surrounding Cincinnati.

19 — *Zygospira recurvirostra*, Hall (Plate I, Fig. 2) — This species is distinguished from *Zygospira modesta* by the broad, shallow median depression of the brachial valve, within which the radiating plications are subequal in size, while in typical *Zygospira modesta* the median depression of the brachial valve tends to be deeper, the radiating plications tend to be more angular, and the middle plication within the median depression usually is distinctly and even conspicuously larger than those at either side. Moreover, in *Zygospira modesta*, the median elevation of the pedicel valve tends to be slightly more evident, and the median groove along this elevation to be slightly more conspicuous. The specimens of *Zygospira recurvirostra* here figured were obtained at the railroad cut 65, one mile north of the station at Cynthiana. Similar forms occur at many localities between Rogers Gap and Sadieville, and at numerous localities elsewhere in the Trenton. The types were obtained in the Trenton of New York.

20 — *Protozyga obsoleta*, sp. nov. (Plate II, Figs. 10A, B) — The typical forms of this species can be described most briefly by stating that they look like specimens of *Zygospira recurvirostra* in which the radiating plications have failed to appear, or in which these radiating plications are barely indicated. Since some of the specimens preserve fine concentric markings, it seems incredible that any process of exfoliation could have left any specimens of *Zygospira* with surfaces sufficiently smooth to be mistaken for shells in which plications were absent or faint. On the other hand, associated with these smooth individuals, in the same layers, there are others in which the degree of plication is much more pronounced, and which may eventually turn out to belong to other species; however, for the present, these more strongly plicated forms are correlated with the typical smooth ones, since the plications do not extend back as far as the beak, but are distinct only along the anterior half of the shell. In size and number these plications resemble those of *Zygospira*. The pedicel valve is flattened along a narrow, obscure elevation medially, as in *Zygospira*, but the depression of the brachial valve does not extend as far toward the beak, and along the junction of the valves, laterally, the shell, in mature forms, is less angular. The largest specimens seen do not exceed 9 mm. in width. The reference to *Protozyga* is only provisional. The illustrations of *Protozyga exigua* indicate shells wider posteriorly, with a more angulate outline, while those of *Protozyga obsoleta* are more rounded, and widest near the middle. Forms of this kind, associated with *Orthorhynchula*, have long been known from the railroad cut about two miles south of Millersburg, a short distance above track level, north of an overhead bridge. *Columnaria* is abundant in the underlying layers. The horizon is in the lower part of the Millersburg member of the Cynthiana formation. Recently my attention was again attracted to these brachiopoda by Dr. E. O. Ulrich. About 50 specimens were collected, varying from forms quite smooth to those in which the plications are conspicuous. Eventually it will be possible to work out the brachidium and thus to determine the affinity of the various forms with accuracy. *Protozyga exigua* is figured on plate 54 of the Paleontology of New York, volume VIII.

21 — *Pterinea (Caritodens) demissa,* Conrad — A left valve, measuring 45 mm. along the umbonal elevation from the beak to the posterolateral outline, was found at the railroad cut 58.1 miles from Ludlow. *Pterinea demissa* is not listed by Nickles from any part of the Eden at Cincinnati. It is figured on plate II, of volume II, of the Paleontology of Ohio.

22 — *Byssonychia vera,* Ulrich (Plate I, Fig. 15) — A species apparently identical with *Byssonychia vera* occurs at the railroad cut south of Rogers Gap, and also at 59.1, 58.5, 57.4, 56.4, 55.0, and 54.3 miles from Ludlow. It possesses 50 radiating plications, and has the same general outline as the Lower Eden form, but the hingeline is somewhat longer and the posterior outline is more erect where it meets this hingeline.

23 — *Byssonychia byrnesi,* Ulrich (Plate III, Fig. 6) — A form resembling this species was found at the railroad cut south of Rogers Gap. Since *Byssonychia byrnesi* was described from the beds below the Fulton horizon at Covington, opposite Cincinnati, this reference probably is correct.

24 — *Allonychia flanaganensis,* Foerste (Plate II, Figs. 1A, B) — This species is characterized by the long hingeline and the very oblique anterior and posterior margins, producing an elongate rather than erect form. The shell is strongly convex, the anterior slope of the more gibbous specimens being practically vertical, excepting where the protusion of the byssal opening takes place. The shell is gibbous even at the beak, the interior cast of which is pointed and curved toward the front. While the shell anteriorly was very thick, posteriorly it seems to have been much thinner. The radiating plications are very flat, and are separated by very narrow and shallow grooves, so as readily to escape detection in the specimens found so far. About five of these plications occupy a width of 4 mm. This species is very abundant at the base of the Millersburg division of the Cynthiana limestone, 2 miles north of Flanagan and 3 miles north of Paris.

25 — *Modiolopsis rogersensis* sp. nov. (Plate III, Figs. 3A, B, C, D) — This species is fairly common at the railroad cut 59.1 miles from Ludlow, and occurs also at the cut south of Rogers

Gap, and at 59.8, 59.7, 59.5, 55.0, 54.6, and 54.3. It belongs to the group of species in which the upper margin, anterior to the beak, descends rather rapidly below the level of the cardinal outline posterior to the beak, rounding strongly into the anterior outline, which extends only 5 or 6 mm. in front of the beak in shells 55 mm. in length. Shells larger than this in size are rare. The basal margin usually makes an angle of about 22 degrees with the cardinal outline. It rounds into the posterior margin. The latter meets the cardinal outline obliquely at an average angle of about 45 degrees, provided the general convexity of this part of the posterior margin be ignored. The umbonal ridge is only moderately angular toward the beak, and posteriorly it merges into the general convexity of the shell. Anteriorly there is a weakly defined mesial sulcus, sometimes almost obsolete, which leaves the basal margin of the shell practically straight or slightly convex. The anterior muscular scar is well defined.

Compared with *Modiolopsis oblonga,* Ulrich, from the strata below the Fulton layer at Covington, opposite Cincinnati, the basal margin is more divergent from the cardinal outline; the posterior outline is less truncate and more rounded, so that the point of greatest curvature is farther above the basal outline; and the junction of the cardinal and posterior margins, instead of being subangular, is more nearly rounded. Moreover, compared with the height, the shell is relatively shorter. While *Modiolopsis rogersensis* evidently is closely related to *M. oblonga,* it is sufficiently distinct for purposes of discrimination. The type of *Modiolopsis oblonga* is quite strongly and evenly convex, with no well defined umbonal ridge.

26 — *Orthodesma* cf. *subnasutum,* Meek and Worthen (Plate I. Fig. 11) — A small lamellibranch, 34 mm. in length, and nearly 13 mm. in height posteriorly, was found at the railroad cut 59.1 miles from Ludlow. It bears a general resemblance to *Orthodesma subnasutum,* from the Trenton of Illinois, in form and in the presence of low, broad, concentric undulations, but the anterior part is less depressed below the cardinal margin. The umbonal ridge is distinct toward the beak, merging into the general convexity

of the shell posteriorly. Anterior to this umbonal ridge, from the appressed beaks to the basal margin, the shell is strongly flattened, the mesial sinus being almost obsolete. Posteriorly, the shell is not obliquely truncated, but the basal margin rounds strongly into the much less convex and very oblique posterior margin, without any indication of straightening anywhere. The shell apparently gapped anteriorly and posteriorly, but this can not be verified with certainty.

27 — At 59.7 and 59.1 miles from Ludlow there are found larger forms of *Orthodesma,* 12 mm. in thickness from valve to valve, which evidently belong to the same group as *Orthodesma rectum.* All of the specimens found so far are fragments, but the original length must have been at least 60 mm. There are evidences of concentric markings, but these are more numerous and much less distinct than in the form resembling *Orthodesma subnasutum,* and for the present these larger forms are considered distinct.

28 — The anterior part of an *Orthodesma* (Plate III, Fig. 2), belonging to the same division of the genus as *Orthodesma nasutum,* Conrad, was found at the railroad cut 59.1 miles from Ludlow.

About 20 miles northeast of Rogers Gap, at the railroad cut one mile north of the station at Cynthiana, a nearly entire valve of a similar species (Plate III, Fig. 1) was found, which, however, may not be identical. Compared with *Orthodesma nasutum,* Conrad, the Cynthiana specimen is a little higher; more convex, especially along the hingeline toward the beak, where the shell is incurved; posteriorly, the hingeline curves downward into the posterior margin at a greater distance from the beak, thus producing a more sub-parallel effect between the cardinal and basal margins.

29 — *Lyrodesma subplanum,* Ulrich — Several specimens which may be referred to this species were found at the railroad cut 59.1 miles from Ludlow. The species was described from the beds below the Fulton horizon at Covington, opposite Cincinnati. The species is figured on plate 47 of the Geology of Ohio, volume VII.

30 — *Cycloconcha oblonga,* sp. nov. (Plate I, Fig. 6) — The shell figured has a thickness from valve to valve of scarcely 5 mm. If it be a species of *Cycloconcha* (*Orthodontiscus*), it differs from species previously described in its oblong form and the position of the beak nearer the anterior margin. The cardinal outline is comparatively straight, and the basal margin is less curved than in previously described species of the genus. Found at the railroad cut 59.1 miles from Ludlow. *Cycloconcha ovata,* Ulrich, occurs in the Southgate and Economy divisions of the Eden, at Cincinnati.

31 — *Fusispira* cf. *sulcata,* Ulrich (Plate III, Figs. 4, 5) — This species, described from Rogers Gap, was founded chiefly upon the presence of several more or less obscure revolving furrows on the cast of the interior of the shell used as a type. If these interior furrows are a constant feature, the species has not been found since, during the numerous investigations of the type localities. However, specimens closely agreeing in form, but lacking the furrows, are not rare, and possibly may belong to the same species. They are most frequent at the cut 59.1 miles south of Ludlow, but have been found also at 59.8, and at the cut immediately north of Sadieville, north of the railroad bridge. *Fusispira sulcata* is figured on plate 53 of the Geology of Minnesota, volume III.

32 — *Hormotoma terebriformis,* sp. nov. (Plate III, Figs. 8A, B) — This species has some resemblance to *Hormotoma bellicincta,* Hall, and it is upon this resemblance, in the absence of the surface markings or of the aperture, that the generic reference is based. Compared with *Hormotoma bellicincta,* from the Trenton of New York, however, it is a longer and more slender species. Only casts of the interior are known. The whorls are rather evenly convex. There is no angulation suggesting the location of a peripheral band, as in the *augustina* division of the genus *Lophospira.* In the type specimen, found at the second railroad cut north of Rogers Gap, there is an apical angle of about 20 degrees; five whorls are well preserved, the body whorl is imperfectly indicated; and at least three whorls are missing at the apical

end, with the probability of two more at the very tip, making a total of at least nine whorls, and probably even eleven whorls in a length of about 120 mm., taking into account the space probably occupied by the aperture. The later whorls do not overlap the base of the earlier whorls as in *Fusispiro*. The largest well preserved whorl, next the body whorl, has a width of 26 mm. and a vertical height of 20 mm. Where the width of the shell is 15 mm., the vertical height of the whorl is nearly 11 mm. Although the shell was fairly thick at the sutures, there is no evidence that it was of more than ordinary thickness elsewhere. The interior casts of the whorls are fairly evenly convex. Other specimens having the same form occur at the railroad cuts 59.1, 57.4, and 54.5 miles south of Ludlow.

At 59.1 a specimen was found whose lower whorl was slightly angulate along the lower side, where it curved into the suture. Although this may belong to the same species as the preceding, there is a bare possibility of it belonging to the same division of the genus *Lophospira* as the Trenton species *Lophospira augustina*. It is represented by Fig. 9 on plate III.

33 — *Lophospira* sp. (Plate III, Fig. 10) — A small Lophospira, apparently an undescribed species, with a maximum height of 20 to 23 mm. is rather common at the railroad cut 59.1 miles from Ludlow. The feature which distinguishes this form from *Lophospira abnormis*, Ulrich, described from strata below the Fulton layer at Covington, opposite Cincinnati, is the presence of a revolving ridge or carina a short distance below the suture. The slope between this carina and the well marked peripheral angle is only moderately concave. There is rather indistinct evidence also of the presence of a carina on the lower slope of the last whorl, so placed as to be hidden by the line of suture of the enlarging shell. Since the lines of growth or surface striæ are not preserved, the form of the sinus can not be determined, so that the exact affinities of the species can not be determined. Moreover, no bordering lines can be detected along the peripheral angle. The slope between the sub-sutural carina and this peripheral angle is only moderately concave. A vertical section somewhat resembles that

of *Lophospira bicincta,* but the peripheral angle is more prominent.

34 — *Liospira vitruvia,* Billings — This species is referred provisionally to *Liospira vitruvia* on account of the frequency with which the umbilical cavity is exposed in the casts at hand. The specimens usually do not exceed 15 mm. in diameter, and nothing is known of the surface striations. The species is common at the railroad cut 59.1 miles from Ludlow, and occurs also at 60.3, 59.7, and 54.3 miles from Ludlow. The most striking feature of this species is the relatively deep and wide sutural depression shown by the casts of the interior, especially in case of the last whorl, the slope changing abruptly a short distance from the suture, producing, in the cast, an angular ridge on the side away from the apex of the shell, the curvature on the apical side being more rounded. *Liospira vitruvia* is figured on plate 69 of the Geology of Minnesota, volume 3.

35 — *Hormotoma gracilis,* Hall (Plate I, Fig. 3) — Specimens having the apical angle and oblique whorls of the variety *sublaxa,* as figured by Ulrich, occur at the railroad cut 59.1 miles from Ludlow. Unfortunately they are only casts of the interior, and the surface striæ are unknown.

36 — *Holopea incerta,* sp. nov. (Plate I, Fig. 4) — This species most closely resembles in form *Holopea concinnula,* Ulrich and Scofield, and differ chiefly in the last volution or body whorl being relatively of less height, approaching in this respect *Holopea excelsa,* of the same authors, which is, however, a much taller and larger shell. The types occur at the railroad cut 59.1 miles from Ludlow, and similar specimens were found apparently also at 54.2.

37 — *Cyclonema varicosum-cincinnatense,* Miller (Plate I, Fig. 12A, B) — This variety differs from *varicosum* chiefly in its smaller size; it is characterized by the strong and comparatively equidistant transverse striæ, which number about 5 to 7, occasionally 8, in a width of 2 mm. along the periphery of the largest or body whorl. Revolving carinæ of that part of the whorl which remains above the suture line are rather strong; of these the one

nearest the suture on the apical side is rather distant from that suture, the next three interspaces are not as wide, and the last three, as far as the lower suture, are distinctly narrower. Below the periphery corresponding to the suture line, the last or largest whorl possesses four or five additional carinæ, less distinct than those above, and gradually becoming less distinct the more distant they are from the periphery. The spaces between the carinæ are occupied by additional sharp striæ, of which there are usually four in the wider spaces, the central one being somewhat stronger; only one additional striation occurs as a rule in the narrower spaces, and similar striations occur on the lower slope of the body whorl below the lowest striations which can still be called carinæ. However, on this lowest part of the body whorl, the transverse striations are more prominent than the revolving striations. The inner lip of the aperture is nearly vertical. The variety evidently is closely related to *Cyclonema varicosum*, Hall, but it is a distinctly smaller form, the largest specimens found so far not exceeding 20 mm. in width, and the revolving carinæ are correspondingly less prominent. The chief distinguishing feature is the lower spire, producing a relatively wider and flatter shell. The most numerous specimens occur at the railroad cut 59.1 miles from Ludlow; other specimens occur at 60.3, 59.8, 59.7, 59.5, 59.3, 58.9, 58.8, 58.3, 55.7, 54.6, and 54.3 miles from Ludlow. *Cyclonema cincinnatense* was described originally by S. A. Miller from strata below the Fulton layer at Cincinnati and in the immediate vicinity. Ulrich regarded it as identical with *Cyclonema varicosum*, and it is listed under the latter name by Nickles.

38 — *Tetranota obsoleta*, Ulrich and Scofield — A species of *Tetranota* is very common at the railroad cut 59.1 miles from Ludlow. It occurs also at 59.7. It is similar to *Tetranota obsoleta* in the distinctness of the four revolving ridges on the younger parts of the shell, and their comparative indistinctness on the last volution. Usually the lateral volutions are almost obsolete on the last volution, and the two central volutions are united so as to form a convex central ridge, but occasionally specimens are found in which these adolescent features remain fairly distinct, even in fully ma-

ture specimens. Compared with the type of *Tetranota obsoleta,* these Rogers Gap specimens are more flattened dorsally and the umbilicus appears relatively larger. In the vicinity of Cincinnati, Nickles lists *Tetranota bidorsata* from the strata below the Fulton layer, while *Tetranota obsoleta* is listed only from the lower third or Economy division of the Eden. However, since *Tetranota obsoleta* was described by Ulrich as ranging from the Stones River through the Black River and Trenton to the Eden, the reference of the Rogers Gap form to the latter species is probably correct. *Bellerophon globularis,* Miller and Faber, is probably a *Tetranota. Tetranota obsoleta* is figured on plate 65 of the Geology of Minnesota, volume 3.

39 — *Cyrtolites retrorsus,* Ulrich — A form referred to this species was found at 58.8 miles from Ludlow. It ranges from the Trenton into the lower third or Economy division of the Eden. *Cyrtolites retrorsus* is figured on plate 63 of the Geology of Minnesota, volume 3.

40 — *Bellerophon rogersensis,* sp. nov. (Plate 11, Figs. 4A, B, C) — A species of *Bellerophon* is very common at the railroad cut 59.1 miles from Ludlow. It occurs also at 60.3, 59.8, 59.7, 59.5, 58.3, and 54.8. It is very imperfectly known, but probably represents a new species. It is closely related to the group of shells typified by *Bellerophon recurvus,* Ulrich, in which the aperture is only moderately expanded laterally, producing an elongate, rather than laterally widened outline of shell, when viewed from the dorsal side of the aperture. In the Rogers Gap species the aperture appears even less expanded laterally than in the upper Maysville species cited above. The lower margin of the lip is turned back so as to cross the central part of the umbilicus and thus practically close the latter. The shell itself is not preserved. The carina on the casts of the interior is low and rounded, often becoming quite indistinct on the last half of the last volution. The specimens often appear laterally compressed, but this is regarded as due to their state of preservation in a more or less argillaceous rock.

In the massive coarse-grained limestone found on the eastern side of the railroad, below track level, at 58.9 miles from Ludlow, a small fragment of a *Bellerophon* was found which preserved a portion of the shell along the carina. The slit-band had a width of three-fourths of a millimeter, and consisted of two distinctly defined lines between which were the relatively distinct concave lines crossing the band; the depression of the latter below the level of the limiting lateral lines is almost imperceptible. The elevation of the band above the general convexity of the shell is slight. The transverse striæ bend back only moderately on approaching the slit-band, very much less than in *Bellerophon recurvus*, perhaps about as much as in *Bellerophon subglobulus*. It is not certain that this specimen belongs to the same species as *Bellerophon rogersensis*, although it occurs in strata in which the latter species might be expected.

41 — *Conularia trentonensis-rogersensis*, var. nov. (Plate, 1, Fig. 16) — Specimen laterally compressed owing to its preservation in a relatively soft argillaceous rock. Originally with four equal faces separated by distinctly impressed sulci, each face subtending an angle of about 13 to 15 degrees. Faces flat or only slightly convex, transversely striated. The striæ are oblique, rising from the sides toward the median part of the face in the form of an inverted and very much flattened letter V with rounded apex. Not all of the striæ pass continuously across the median part of the face. This is indicated by the fact that there are a few spots on the shell where four transverse striæ on one side of the median part occupy the same interval as three striæ on the other side. Where the face has a width of 20 mm., about 11 striæ occupy a length of 5 mm., measured transversely to the striæ. The transverse striæ are very narrow, equalling scarcely a tenth of a millimeter, and are crowned with a row of minute granules, of which there are about 13 in a width of 13 mm. Between the sharp, narrow, transverse striæ there is a series of short longitudinal striæ, corresponding in number to the minute granules cresting the transverse striæ immediately above, toward the larger end of the shell.

Shell extremely thin, of a pearly white color. The type was found at the railroad cut 59.1 miles from Ludlow.

This form evidently is closely related to *Conularia trentonensis*, from the Trenton of New York. In the latter species, the transverse striæ are not as narrow, so that they appear stronger, and the intermediate spaces are not as wide as in the Rogers Gap form. Moreover, the vertical striæ are much narrower, leaving room frequently for still finer intermediate striæ, visible only under a lens. The faces of the shell are more convex, and the sulci at the angles are more deeply impressed. The shell substance in all specimens seen is black, but this may have no significance, since the enclosing rock also is black. In the Rogers Gap form, the interspaces between the vertical striæ are too narrow to admit of intermediate striæ.

42 — *Orthoceras rogersensis*, sp. nov. (Plate 1, Figs. 17A, B) — Shell increasing from 16 to 24 mm. in a length of 72 mm. This is equivalent to an angle of about 6 or 7 degrees. In any part of the shell, the number of chambers in a length equal to the average width of the shell equals six or seven. The septa are moderately concave. The siphuncle is more or less excentric. Where it passes through the septum its width equals about one-tenth of the width of the shell. Within the chambers the siphuncle expands at once, close to the septum, so that where the siphuncle has a diameter of 1.5 mm. in passing through the septum, its width immediately within the chamber equals 2.0 mm., and toward the central part of the chamber it equals about 2.75 mm., the interval between the septa being 3.7 mm. This corresponds to only a moderate widening of the siphuncle within the chambers as ordinarily exposed in weathered specimens, the narrow passage through the septum not being visible in such specimens. The shell is rarely preserved. It is very thin and comparatively smooth. Under a lens, however, both transverse and longitudinal striæ may be seen. Of these the longitudinal striations are low and broad, about 9 to 11 in a width of 5mm. The transverse striæ are much narrower, sharper, and at more irregular intervals, but also number frequently 10 in a length of 5 mm. On some parts of the shell

the transverse striæ are rather indistinct, even under a lens: on other parts they are sufficiently distinct to somewhat obscure the longitudinal striæ. The type specimens were found at the railroad cut 59.7 miles from Ludlow. The species is common also at 59.1, and specimens occur at 59.8, 58.5, 58.3, 56.8, 56.4, 54.6, and 54.2.

Since the vertical striæ, under a lens, are spaced at equal intervals, and evidently are as permanent, and usually even more prominent features than the transverse striæ, it is evident that this species is distinct from *Orthoceras transversum*, Miller, which ranges throughout the Eden, or the transversely striated form occurring in the beds beneath the Eden, at Cincinnati, identified by local geologists as *Orthoceras junceum*, Hall. *Orthoceras albersi*, Miller, listed by Nickles from the beds below the Eden at Cincinnati, is described as having fine longitudinal lines that increase in number with the enlargement of the shell, by implantation, and are disposed to a fascicular arrangement that gives the shell the appearance of being longitudinally furrowed. If the illustration accompanying the original description was intended to indicate this fasciculation, then our specimen presents nothing similar. Moreover, *Orthoceras albersi* is described as enlarging to twice the diameter in a length of two inches, giving a larger apical angle, and no mention is made of transverse striæ.

43 — *Isotelus.*— At my request, Dr. E. O. Ulrich prepared the following descriptions of *Isotelus benjamini* and *Isotelus covingtonensis*, two new species from the Cynthiana formation at Covington, and elsewhere in north-central Kentucky. These descriptions were accompanied by figures 1 and 4, which are post-lateral outlines of cranidia, and figures 2 and 3, which indicate the outlines of cranidia anterior to the palpebral lobes. These species are to be credited to Ulrich, and are based upon type material preserved in the U. S. National Museum, at Washington.

Isotelus benjamini, Ulrich. Compared with *Isotelus gigas.*—

1 — The genal spines are retained through life, while in *I. gigas* they are entirely resorbed before the individual attains a length of 3 to 4 inches.

2 — The eyes have a more anterior position.

3 — The glabella descends more abruptly anteriorly into the intramarginal groove.

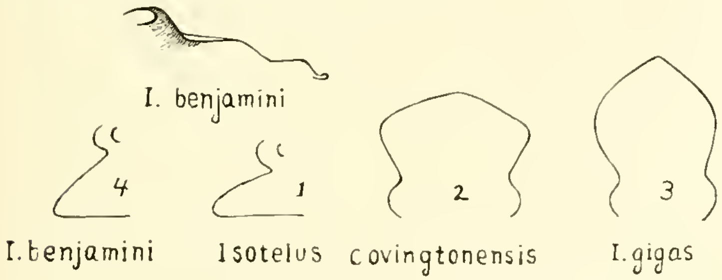
4 — The intramarginal groove is of greater depth and width, and, consequently, the marginal rim is of a more pronounced character.

5 — The pygidium is more rounded and less triangular in outline.

6 — The convexity of the pygidium is more uniform, there being scarcely a suggestion of a flattened border.

7 — The species is inferior in size, most of the specimens being under 3½ inches in length and none probably exceeding 4½ inches.

8 — The cranidium is elongate as in *Isotelus gigas,* but is not quite as long or as triangular. (Fig. 3.)



Isotelus covingtonensis, Ulrich. Compared with *Isotelus benjamini* —

1 — The outline of the cranidium in the antero-lateral part is subangular, and, consequently, the preocular part is shorter (Fig. 2). The corresponding part of the outline of *I. benjamini* is more regularly curved, and the cranidium is longer.

2 — The angle formed by the converging edges of the postlateral extensions of the cranidium, between the facial suture and the posterior margin of the cranidium, is smaller (Fig. 1). In *I. benjamini* this angle is wider (Fig. 4).

3 — The development of the marginal rim of the cephalon is less pronounced, the intramarginal groove being of less depth and width.

4 — The intramarginal groove of the pygidium is so much better developed that *I. covingtonensis* may be distinguished by this moderately developed border, while the intramarginal groove of *I. benjamini* is relatively obscure or practically absent.

Isotelus benjamini was identified by Ulrich among specimens collected at localities between Sadieville and Rogers Gap, Kentucky. The specimen represented by Fig. 13 on Plate I came from locality 54.5 miles from Ludlow. The facial margin anterior to the palpebral lobes is not indicated in this figure. It curves regularly forward to within a short distance of the margin of the cephalon and then takes a course parallel to the latter. Fig. 5, on page 145, indicates the curvature of the dorsal side of this free cheek, seen along a transverse section from a point anterior to the palpebral lobe. The same species occurs also at 59.1, 59.5, and 59.7, and was identified by Ulrich with less certainty from the locality one mile north of the railroad station at Cynthiana.

Isotelus covingtonensis was identified by Ulrich from the localities 59.7 and 59.1 miles from Ludlow, near Rogers Gap, and also from the locality one mile north of Cynthiana station.

44 — *Trinucleus concentricus*, Eaton — This species occurs at localities 60.3, 59.1, 58.3, 57.8, 57.1, 56.8, 56.4, 55.3, 54.8, and 54.2 miles from Ludlow. At Cincinnati it occurs not only in the lower half of the Eden, but also in the 20 feet of strata immediately underlying the Fulton layer. The layers containing *Eridorthis*, at Brent, belong distinctly below this *Trinucleus* horizon.

45 — *Proetus* sp. — The middle part of a cephalon, 6 mm. long, and lacking the free cheeks, was found at the railroad cut north of Cynthiana. It closely resembles *Proetus undulostriatus*, Hall, as figured by Dr. Ruedemann, possessing also the microscopic transverse lines, whatever these may indicate. However, the oc-

cipital segment is much more strongly bent downward laterally and differs otherwise in form. A small pygidium of *Proctus*, about 2.5 mm. in length, was found at the railroad cut north of Rogers Gap, about 55.8 miles from Ludlow. The axial segment rises strongly above the only moderately convex lateral parts. These fragments may not belong to the same species. *Proetus undulostriatus* is figured by Ruedemann on plate 9 of Bulletin 162, published by the New York State Museum.

46 — *Dalmanites achates*, Billings (Plate I, Fig. 18) — A species closely related to *Dalmanites achates*, Billings, from the Trenton of Ottawa, Canada, and Trenton Falls, New York, is represented by an imperfect cephalon found at railroad cut 54.8 miles from Ludlow. The chief characteristic of this species is the transversely much elongated frontal lobe of the glabella, with a moderately convex anterior margin. The glabellar lobation, the position of the eyes, the length and form of the genal spines is identical with that of *Dalmanites achates*. A rather elongate pygidium, found at the cut 55.8 miles from Ludlow, may belong to the same species, but this is uncertain. It occurred in the same rock fragment with the pygidium of *Proctus* mentioned above. The glabella, including the smaller lobes, the occipital segment, and even the fixed cheeks is ornamented with relatively distant large and small granules. Apparently the same species occurs at the first large exposure west of bridge 54, west of the Million tunnel in Madison County, Kentucky, about 10 feet above the railroad track. If so, the eyes of this species are fully as tall as wide, and strongly facetted. *Dalmanites achates* is figured on page 727 of the Geology of Minnesota, volume 3.

47 — *Acidaspis* sp. — An unknown species is represented by movable cheeks at the railroad cuts 54.8 and 54.6 miles from Ludlow.

48 — *Ceraurus* sp. — The central part of a cephalon, lacking the movable cheeks, was found at 54.5 miles from Ludlow, in the same rock fragment as *Strophomena hallie*, Miller. It belongs to the group with moderately expanded anterior glabella. Specimens

occur at 55.7, but not enough is known to make a specific reference possible.

49 — *Calymene* sp. (Plate I, Figs. 14A, B) — A form of *Calymene* is fairly common at 59.1, 54.8, 54.5 and 54.3 miles from Ludlow, and similar forms occur at 58.8, 58.7, 58.3, 57.8, 56.4, 55.7, 55.3, 54.8, 54.7, and 54.3. The genal angles terminate in a spinose point nearly a millimeter in length.

50 — *Calymene abbreviata*, Foerste, was described from the railroad cut a mile south of Rogers Gap. It was characterized by the straightened anterior margin of the glabella, and a low blunt elevation on the frontal border about opposite the anterior extension of the groove separating the glabella from the fixed cheeks. If these characteristics do not prove constant, there is nothing to distinguish the forms found north of Rogers Gap from the *Calymene abbreviata*. The latter species is figured on plate 3 of the Denison University Bulletin, volume 16.

51 — *Calymene granulosa*, Foerste, described from the lower Eden at Cincinnati, Ohio, does not occur typically in the Rogers Gap fauna, although the *Calymene* of the latter fauna is finely granulose, as is often the case with species belonging to this genus.

Designation of Localities.

All of the specimens illustrated, unless otherwise indicated, were obtained along the railroad between Rogers Gap and Sadieville, in Scott County, Kentucky. The localities indicate the railroad cuts and their distance from Ludlow. Numerous signs, put up by the railroad, make the identification of the exact cut easy. The milepost 60 from Ludlow is located immediately north of the railroad station at Rogers Gap. The mark for 54 miles from Ludlow is on the railroad bridge in the southern part of Sadieville. From these data the relative distance of the various cuts from either Rogers Gap or Sadieville may be determined readily.

Description of Plate I.

Fig. 1 — *Constellaria emaciata*, Ulrich and Bassler — Railroad cut 58.9 miles from Ludlow.

Fig. 2 — *Zygospira recurvirostra*, Hall. — A, brachial view. B, C, pedicel valves. At mile post 65, along the railroad, one mile north of the station at Cynthiana.

Fig. 3 — *Hormotoma gracilis*, Hall — Railroad cut 59.1 miles from Ludlow.

Fig 4 — *Holopea incerta* — Railroad cut 59.1 miles from Ludlow.

Fig. 5 — *Eridorthis nicklesi*, Foerste — Railroad cut 54.5 miles from Ludlow. A, B, brachial valves, the second showing the median groove at beak, and anterior fold. C, pedicel valve, showing the median depression.

Fig. 6 — *Cycloconcha oblonga* — Right valve.

Fig. 7 — *Ohiocrinus exilis* — Railroad cut 59.1 miles from Ludlow. Showing the radials and brachials of the right anterior and right posterior arms, with the two lower anal plates.

Fig. 8 — *Ectenocrinus grandis*, Meck — A, view of right side of head, showing the long, slender, straight ramules; railroad cut 54.5 miles from Ludlow. B, left anterior and left posterior arms; railroad cut south of Rogers Gap. C, left anterior and left posterior arms, with two lower anal plates. D, lower part of the column belonging to the same specimen as Fig. C; railroad cut 59.1 miles from Ludlow.

Description of Plate I, Continued.

Fig. 9 — *Strophomena higginsportensis*, Foerste — Interior of pedicel valve. Railroad cut 59.1 miles from Ludlow.

Fig. 10 — *Lichenocrinus subaequalis* — Two basal attachment discs with traces of the lower part of the column. Railroad cut 59.8 miles from Ludlow.

Fig. 11 — *Orthodesma* cf. *subnasutum*, Meek and Worthen — Railroad cut 59.1 miles from Ludlow.

Fig. 12 — *Cyclonema varicosum-cincinnatense*, Miller — Railroad cut 59.1 miles from Ludlow.

Fig. 13 — *Isotelus benjamini* — Free cheek; spine of large specimen, with anterior part not exposed at the time the figure was prepared. Recent cleaning shows that the facial suture curves very gradually forward until near the border of the cephalon. Railroad cut 54.5 miles from Ludlow.

Fig. 14 — *Calymene* sp. — A, enrolled specimen showing head with acute genal spines; north of Rogers Gap. B, central part of head; north of Rogers Gap.

Fig. 15 — *Byssonychia vera*, Ulrich — Posterior outline not preserved, but inferred from direction of growth lines. Railroad cut south of Rogers Gap.

Fig. 16 — *Conularia trentonensis-rogersensis* — Two faces, pressed flat. Railroad cut 59.1 miles from Ludlow.

Fig. 17 — *Orthoceras rogersensis* — A, specimen showing fine longitudinal and transverse striæ; railroad cut 59.7 miles from Ludlow. B, specimen showing siphuncle along part of its length; the lateral outline is supplied in the drawing from other specimens in which it is distinctly preserved; railroad cut 59.7 miles from Ludlow.

Fig. 18 — *Dalmanites achates*, Billings — Railroad cut 54.8 miles from Ludlow. Cephalon preserving long genal spine; impression of lower surface of the parts presented.

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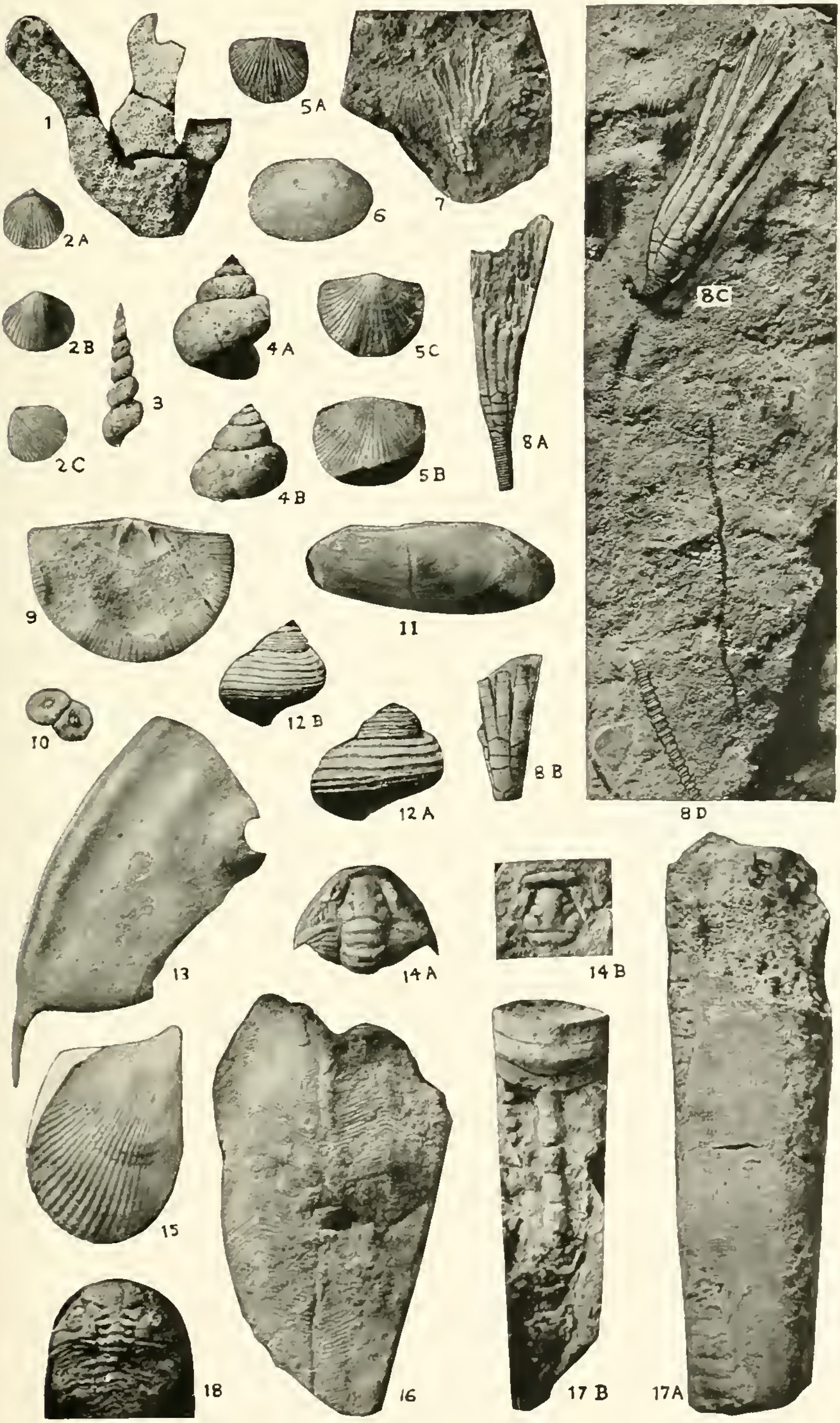
VOL. XXI, No. 4. PLATE I.



THE ROGERS GAP FAUNA OF CENTRAL KENTUCKY

Description of Plate II.

Fig. 1 — *Allonychia flanaganensis*, Foerste — A, cast of interior of left valve, indicating the width of the hinge area. B, cast of the right valve. About two miles north of Flanagan, in the basal beds of the Cynthiana formation.

Fig. 2 — *Lingula cincinnatiensis*, Hall and Whitfield — Fairmount division of the Maysville formation, Cincinnati, Ohio.

Fig. 3 — *Lingula* cf. *cincinnatiensis* — Railroad cut 59.1 miles from Ludlow.

Fig. 4 — *Bellerophon rogersensis* — A, B. dorsal views, presented to indicate the low dorsal elevation presented by the casts of the interior. C, lateral view of the cast of the interior. No specimens preserving accurately the form of the aperture have been found. Railroad cut 59.1 miles from Ludlow.

Fig. 5 — *Strophomena hallie*, Miller — A, brachial valve. B, interior of brachial valve. Railroad cut 54.3 miles from Ludlow.

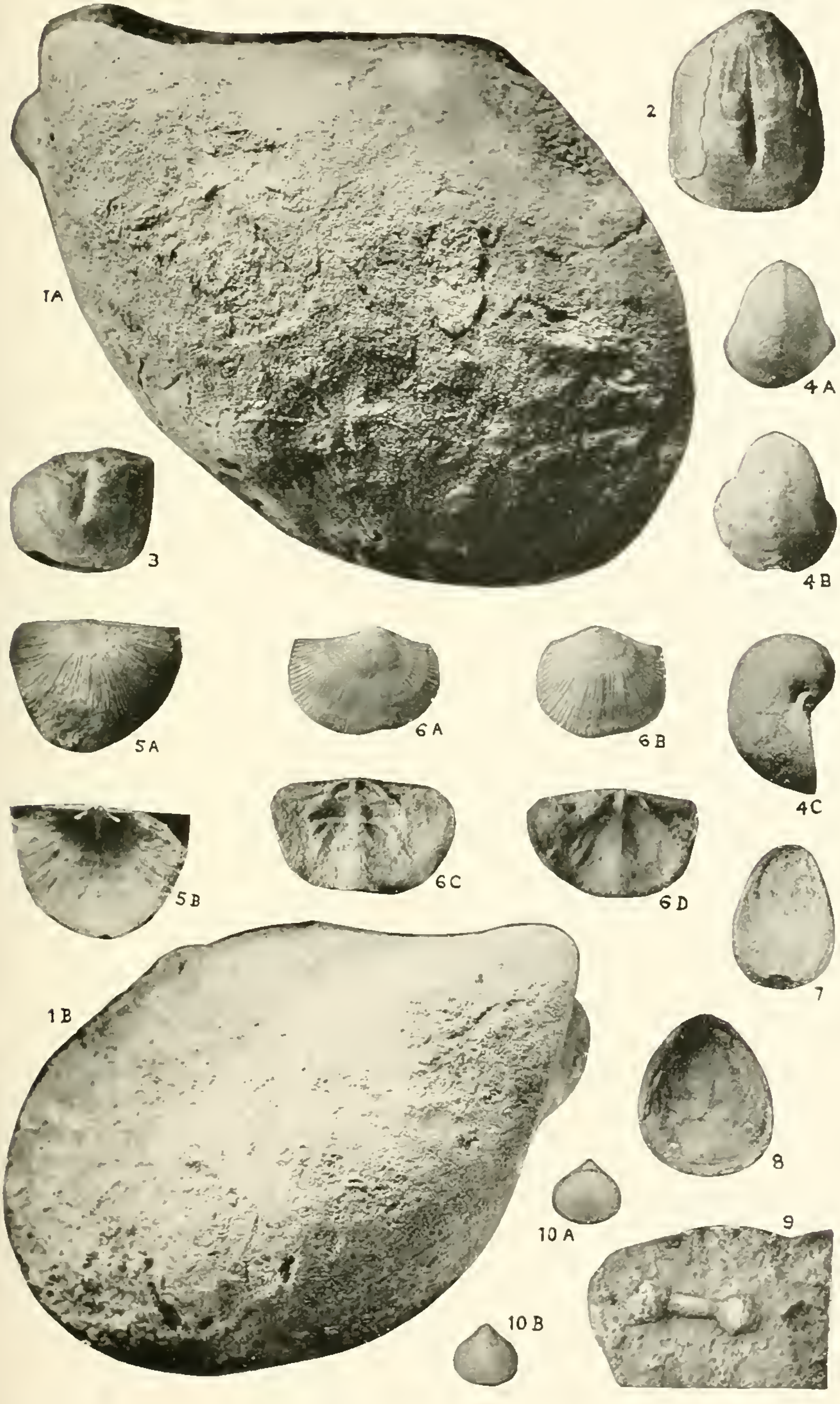
Fig. 6 — *Clitambonites rogersensis*, Foerste — A, B, pedicel valves; railroad cut 54.5 miles from Ludlow. C, D, interiors of brachial valves; north of Rogers Gap, probably at 59.1 miles from Ludlow.

Fig. 7 — *Lingula* cf. *procteri*, Ulrich — Brachial valve, interior. Railroad cut 55.8 miles from Ludlow.

Fig. 8 — *Lingula whitfieldi*, Ulrich — Brachial valve, interior. Railroad cut 57.5 miles from Ludlow.

Fig. 9 — *Arthrcria* cf. *biclavata*, Miller — Railroad cut 59.1 miles from Ludlow.

Fig. 10 — *Protozyga obsoleta* — A, brachial valve. B, pedicel valve. Two miles south of Millersburg, immediately south of the bridge crossing the railroad, at the top of the *Columnaria* zones in the lower part of the Cynthiana formation.



THE ROGERS GAP FAUNA OF CENTRAL KENTUCKY

Description of Plate III.

Fig. 1 — *Orthodesma* cf. *nasutum*, Conrad — Right valve. Railroad cut at milepost 65, one mile north of the station at Cynthiana.

Fig. 2 — *Orthodesma* cf. *nasutum*, Conrad — Anterior half of left valve, possibly belonging to a different species than Fig. 1. Railroad cut 59.1 miles from Ludlow.

Fig. 3 — *Modiolopsis rogersensis* — A, B, C, three right valves, casts of the interior. D, left valve, imperfect posteriorly.

Fig. 4 — *Fusispira* cf. *sulcata*, Ulrich — Railroad cut 59.1 miles from Ludlow.

Fig. 5 — *Fusispira* cf. *sulcata*, Ulrich — Possibly a different species from the preceding, with flatter volutions. Railroad cut 59.1 miles from Ludlow.

Fig. 6 — *Byssonychia* cf. *byrnesi*, Ulrich — Cardinal and posterior outlines not distinctly indicated in the original specimen, hence the identification is only provisional. Railroad cut south of Rogers Gap.

Fig. 7 — *Hebertella latasulcata* — A, pedicel valve; railroad cut 58.1 miles south of Ludlow. B, interior of pedicel valve, showing the form of the muscular scar; railroad cut 55.8 miles south of Ludlow.

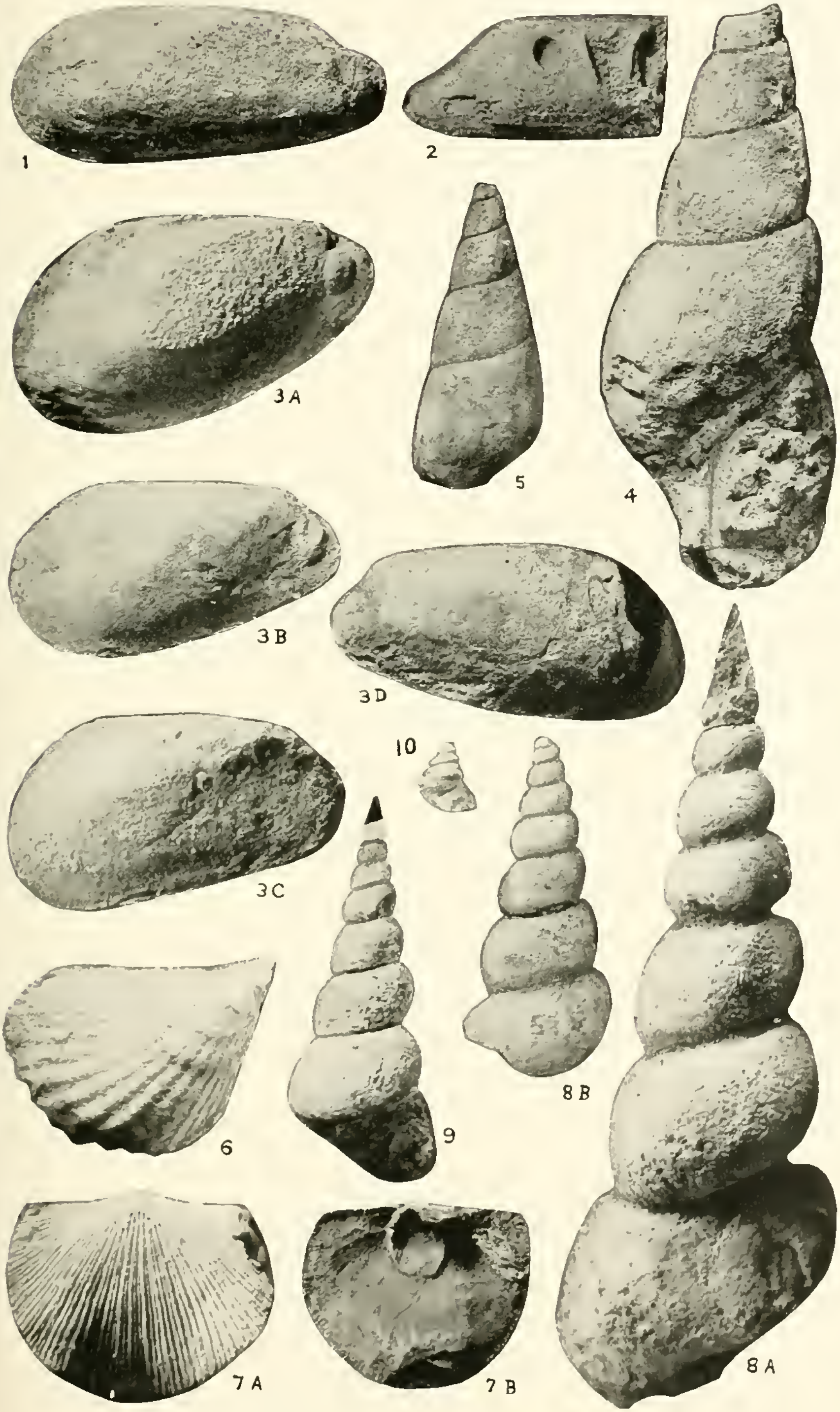
Fig. 8 — *Hormotoma terebriformis* — A, cast of interior, imperfect at top, but with original length of shell indicated; from railroad cut 59.7 miles south of Ludlow. B, a similar specimen from the railroad cut 54.5 miles south of Ludlow.

Fig. 9 — *Lophospira* — Apparently belonging to the *augustina* group. Form of aperture unknown. Railroad cut 59.1 miles from Ludlow.

Fig. 10 — *Lophospira* sp. nov.— Railroad cut 59.1 miles south of Ludlow.

In the preceding plates the apertures of all of the gasteropoda are unknown, and no attempt has been made to represent the proper form of the aperture, so that no conclusions regarding the aperture should be drawn from the illustrations presented.

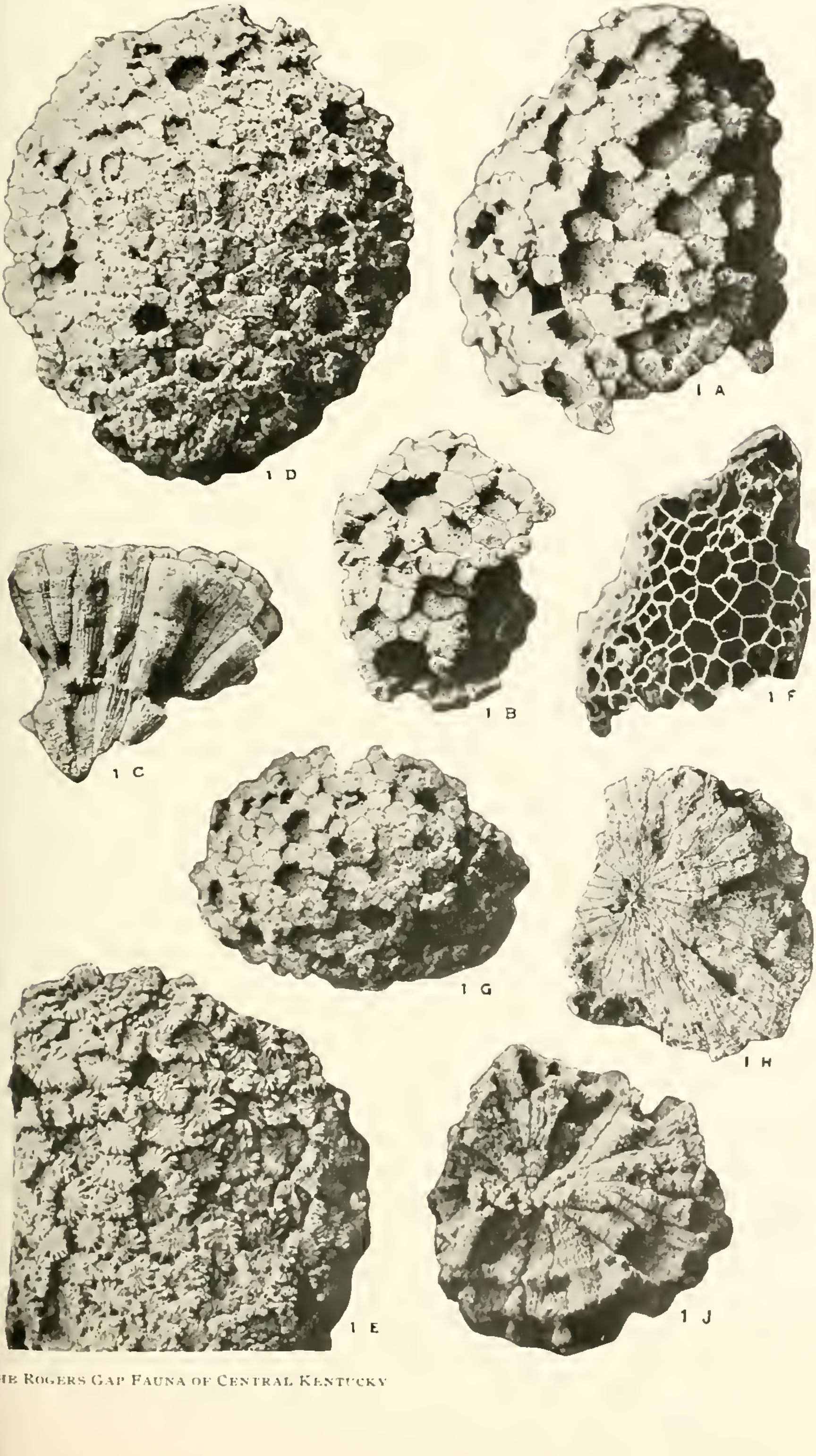
The Journal of the Cincinnati Society of Natural History
VOL. XXI, No. 4 PLATE III.



THE ROGERS GAP FAUNA OF CENTRAL KENTUCKY

Description of Plate IV.

Figs. 1A-J — *Columnaria alveolata-interventa* — All of the specimens are from the Benson limestone at Stop 11, north of Hulitt station, northeast of Brannon, on the electric railroad from Lexington to Nicholasville. A, B, specimens which have weathered so as to show the larger corallites as depressions surrounded by smaller corallites. C, a similar specimen, showing the strongly divergent corallites. D, G, show similar features in specimens whose corallites do not attain the same size. In E the corallites are more nearly of the same size. C, F, show the vertical wrinkling of the cell walls. D, E, show the strong septa, almost reaching the center, although it is not well brought out by the photoengraving. H, J, basal views, with the lower surface of the corallites flattened in the first case, as though appressed to a flat surface, but semi-cylindrical in the second case, as though free from contact.



THE ROGERS GAP FAUNA OF CENTRAL KENTUCKY

NOTES ON COLEOPHORA, WITH DESCRIPTIONS OF TWO NEW SPECIES (MICROLEPIDOPTERA)

By Annette F. Braun

Coleophora pruniella Clemens.

Coleophora pruniella Clemens, Proc. Ent. Soc. Phil., I, 79, 1861; Tin. No. Am., 167, 1872; Zeller, Verh. zool.-bot. Ges. Wien, XXIII, 309, 1873; Walsingham, Proc. U. S. N. M., XXXIII, 216, 1907; Dyar, List N. A. Lep., No. 6034, 1902.

In his description of the case of this species, Clemens refers to the "tail-like appendage," and one would expect that this character would be immediately recognized and serve as an undoubted means of identifying the species when rediscovered. It is the possession of this characteristic "tail" that has chiefly led me to believe that the species described below is the true *Coleophora pruniella* of Clemens. As it will be seen from the description which follows, it bears no resemblance to the species described by Lord Walsingham under the name *pruniella* Clemens and Walsingham, which was bred on *Prunus demissa*, Placer County, California. I propose the name *Coleophora demissella* for the California species.

Antennæ with the basal joint gray, slightly thickened with scales, without a tuft; the following three or four joints are gray, the remainder almost pure white; all are conspicuously annulated with a dark gray, almost black color. Second joint of the palpi whitish with some dark gray scales externally, and with a minute projecting tuft; third joint dark gray. Head whitish gray.

Thorax and fore wings gray, sometimes brownish tinged, the scales somewhat darker at their tips. Cilia concolorous. Hind wings and cilia almost concolorous with the fore wings. Abdomen gray, with yellow anal tuft in the male. Fore and middle legs in large part fuscous, with the tips of the joints white; hind legs white, tibiæ clothed above with long fuscous hairs, tarsi externally dusted with fuscous.

Expanse: 12.5-13 mm.

The above description is made from three specimens (two males and one female) bred on wild cherry, *Prunus serotina*, at Cincin-

nati. I have also seen a captured specimen from Oak Station, Pa., collected by Mr. Fred Marloff, June 30, 1907.

The cases and larvæ were first noticed on October 2d, when the larvæ were fairly numerous. At this time a few were still inhabiting the first case, made soon after hatching in the summer. This first case appears to be cut from the interior of the leaf, as I noticed many wedge-shaped holes with the angles well rounded off. The case itself is rather regular in outline, somewhat flattened and tapering toward the apex; its length varies from 2 to 3 mm. The larvæ during this period mine into the leaf from the lower side, forming numerous irregular blotches, often confluent with one another.

At this date (October 2d), however, the majority of the larvæ were constructing their second cases, in which they pass the winter and finally pupate. When ready to make the second case, the first case is attached at the margin of the leaf, on the under side, between two serrations, and the larva mines into the leaf toward the midrib, deserting the case. The entire mine is not used in cutting out the case, as the larva usually mines too far toward the midrib. From a point on the margin just below the serration adjacent to the point of attachment of the first case, the larva makes a short oblique cut into the leaf, about parallel to a lateral vein. Then, turning at an acute angle to the first cut, a second much more oblique and longer cut is made, leading upward almost parallel to the margin, which it reaches just above the upper serration next to the attached small case. The mouth of the case is at the point of meeting of the two cut edges. Its upper edge is formed of the shorter oblique

Case of *C. pruniella*, X 3.

54

cut and that portion of the margin of the leaf included between the two oblique cuts, and bearing on its edge the small case, which usually bends toward one side. If the serrations of the leaf margin are small, there may be three or four along this edge. The lower edge of the case is formed from the long oblique cut, and the real apex is at the junction of this cut with the margin of the leaf. These relations will perhaps be made clearer by the accompanying figure. Length of case from mouth to apex: 5-6 mm. The resemblance of the small case to a tail is very striking, and the notches described by Clemens are in reality due to the manner of attachment of this small case to the upper edge of the large case.

In the spring the "tail" is soon lost, but its former position is often easily determined by the short light streak of ocherous silk on the ridge along the upper edge of the case. In the spring the case becomes more rounded out and less flattened than when first made.

The imagoes appeared June 3d and 4th. *Coleophora cerasivorella* Packard, seems to resemble this species closely. If the characters given in the meager description can be relied on at all, the whitish gray antennæ, annulate with white, will distinguish it from *C. pruniella*, in which the contrasting black and white rings on the antennæ are very conspicuous. *C. pruniella* also bears considerable resemblance to *C. fletcherella* Fern., but is distinguished from it by the conspicuously annulated antennæ, as well as by the larger size and browner color. A third closely related species is *C. occidentis*, Zeller, but the case as noted by Zeller is quite different. To the other cherry and apple feeding species, *C. malivorella* Riley, *C. lapidicornis* Wlsm., and the plum-feeding species described below, it has no resemblance whatever.

There is a group of closely related species comprising *Coleophora limosipennella* Dup., *C. caryaefoliella* Clem., *C. ostryae* Clem., and a fourth, a plum-feeder, described below, all characterized by the ocherous or reddish brown color of the wings and the whitish costal streak from the base. Of these, *C. limosipen-*

nella and *C. caryaefoliella* are well known. *C. ostryae* was named from larva and case only, and, as far as I am aware, the imago has not been described. I have a series of fourteen specimens bred on *Carpinus* and *Ostrya*, and the moths are indistinguishable from specimens of *C. caryaefoliella* bred on hickory. There is some variation in the depth of color in the fore wings and in the shading on the tarsal joints, but the limits of variation are about the same as in *C. caryaefoliella*. The case agrees with the description given by Clemens except that the notch near the hinder end is almost always lacking. Allowing for the difference in texture between the leaves of hickory, ironwood and hornbeam, the cases are similar enough to belong to the same species. The habits of feeding are identical. In my opinion, *C. ostryae* should be regarded as a synonym of *C. caryaefoliella*. It may be that the captured specimens taken "a mile away from any hickory trees," from which Chambers described *C. rufoluteella*, were Ostrya-feeders, as the cases are often very common.

Coleophora umbratica, **n. sp.**

Antennæ with the basal joint brownish ocherous, slightly thickened with scales; antennal stalk whitish, annulate with brown, more distinctly toward the apex. Palpi pale ocherous.

Thorax and fore wings brownish ocherous, deeper toward the apex, very pale toward the base. Costal margin from the base to the costal cilia whitish, this whitish color shading imperceptibly into the ground color of the wing, especially near the base. Cilia concolorous with the wings, becoming grayer dorsally. Hind wings brownish gray, cilia gray.

Abdomen brown. Legs brownish ocherous, tibiæ clothed with ocherous or reddish brown hairs.

Expanse: 9-10 mm.

Three specimens from larvæ feeding on wild red plum, *Prunus americana* Marsh, Cincinnati, O. The earliest case is very small, about 1.4 mm. long, and irregularly curved along its upper edge.

The second case is cut from the margin of the leaf, and usually bears along its upper edge one of the serrations of the leaf: its length is 3.5 mm. The third case is formed during the latter part of August; it also is cut from the margin of the leaf, and measures from mouth to apex about 5 mm. The larva hibernates in this case, feeding up in the spring and pupating about the first of June. At this time the case is somewhat flattened, its mouth slightly bent over, the upper edge almost straight with one to three small notches. The lower edge bulges outward in the middle, beyond this it is concave, expanding again at the apex, which is squarely truncate.

Imagoes in June and the early part of July.

This species is distinguished from its nearest ally, *C. caryaefoliella*, by the less clearly limited pale streak along the costa; the difference is well marked when series of the two species are placed side by side.

There is no doubt that a specimen bred on *Prunus americana* and compared by Lord Walsingham with *C. rufoluteella* Cham. (Trans. Ent. Soc. Lond., 430-431, 1882), is a specimen of this species. The description of the case also agrees with that of the present species.

Types in my collection.

Four species, namely, *C. cratipennella* Clem. (syn. *gigantella* Cham.), *C. fagicosticella* Cham., *C. unicolorella* Cham., and *C. quadrilineella* Cham. were described either from specimens bred from cases found adhering to the bark of trees or from captured specimens, the cases being associated with them by subsequent breeding. No food plant was determined for any of them. These four species have been found to be miners in the seed capsules of *Juncus tenuis* Willd., which is very common in beaten paths across lawns and fields, and of *Juncus effusus* L., a swamp rush. In two instances the larva utilizes some portion of the inflorescence in constructing its case. Larvæ of the four species are often found feeding together on a single clump of the food plant.

Coleophora cratipennella Clemens.

Coleophora cratipennella Clemens, Proc. Ent. Soc. Phil., III, 506, 1864; Tin. No. Am., 258, 1872; Busck, Proc. Ent. Soc. Wash., V, 219, 1903; Dyar, List N. A. Lep., No. 6012, 1902.

Syn. *gigantella* Chambers, Can. Ent., VI, 128, 1874; X, 110, 1878; Dyar, List N. A. Lep., No. 6019, 1902.

The case of this species is spun entirely of silk. The early case is whitish, thin and flimsy, much flattened, especially toward the apex, which is two-valved. The case of the mature larva is sub-cylindrical, tapering a little toward the mouth and apex, but expanding at the extreme apex, which is conspicuously three-valved. The general color is grayish ocherous, shading to a more reddish color at the apex. Length of case: 8 mm. Larvæ may be found from the end of June to the first part of August, when they crawl off, often attaching themselves to trunks of trees, where they are easily collected in the spring. Imagoes appear in May and the early part of June, simultaneously with the first blooming of the rush, occasionally later.

Case of *C. cratipennella*, X 1

There is more variation in color than either Clemens or Chambers has described. The color of the streaks varies from pale ocherous to fuscous; in the latter case the general aspect of the insect is gray. As a rule, the paler specimens are females. The annulations of the antennæ of these pale specimens are often indistinct.

The expanse of Clemens' type, given by Mr. Busck, is 14 mm.; this agrees fairly well with the expanse given by Chambers in his original description of *C. gigantella* (5/8 inch). The average size of my specimens is 14.5 mm.

Coleophora fagicosticella Chambers.

Coleophora fagicosticella Chambers, Can. Ent., VI, 129, 1874; X, 111, 1878; Dyar, List N. A. Lep., No. 6017, 1902.

The entire inflorescence, including seed capsule, perianth and bractlets, is used in constructing the case, and surrounds it except at the mouth and apex. That portion of the case immediately behind the mouth (the bent neck at the anterior end, of which Chambers speaks), about .5 mm. in length, is spun of brownish yellow silk. The bractlets at the base of the perianth surround the silken inner case immediately behind this bent neck. Pointing backward are the six sharp teeth of the perinath. Projecting beyond the split apex of the ovary of the flower is the three-valved apex of the silken inner case. Length of case: 5 mm.

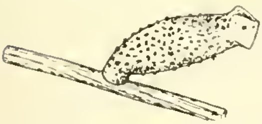
Case of *C. fagicosticella*. X 4

This is probably the commonest species of the four, but the cases are not as easily detected amongst the clusters of seed capsules upon which the larva feeds. In the spring the cases are very plentiful on tree trunks in the neighborhood of the food plant. The dates of emergence of a series of twenty-five imagoes extend from May 22d to June 21st.

Coleophora unicolorella Chambers.

Coleophora unicolorella Chambers, Can. Ent., VI, 129, 1874; X, 111, 1878; Dyar, List, N. A. Lep., No. 6050, 1902.

The case of this species is spun entirely of ocherous or grayish silk with numerous tiny specks of yellowish or brown excrement adhering to it. The case is short, cylindrical, the diameter great in proportion to its length, with the anterior end narrower and bent downward toward the mouth, the posterior end capped with a flat, broad pyramid whose faces form the three valves of the apex. Length of case: 4.5-5 mm. The imagoes in my collection appeared June 19th.

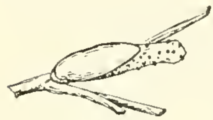


Case of *C. unicolorella*. X 4

Coleophora quadrilineella Chambers.

Coleophora quadrilineella Chambers, Bull. Geol. Surv. Terr., IV, 94, 1878; Dyar, List N. A. Lep., No. 6039, 1902.

This is the smallest species of the four, the case of the mature larva measuring but 4-4.8 mm. in length. The case is a narrow cylinder, tapering to the mouth, three-valved at the apex, and sheathed along its upper surface for three-fourths its length by one of the three divisions of the capsule. The base of the capsule division is fastened just back of the mouth of the case, but does not entirely surround it. As Chambers has described it, the appearance is that of "a clear, shining shield covering its upper anterior portion." The posterior fourth of the case has numerous grains of excrement adhering to it.



Case of *C. quadrilineella*, (X 4)

Chambers' description of the imago is not very accurate. The color of the fore wings would be more properly described as pale grayish ocherous, with the costa white, a white streak along the middle of the wing sending off three or four branches to the costa, a short white streak just beneath the fold, and the dorsal margin sometimes white. The antennæ are whitish, annulate with brown basal joint thickened with scales. Second joint of the labial palpi with a minute projecting tuft.

There seem to be two generations a year. Larvæ feeding on the capsules during the early part of July produce imagoes during the latter part of the same month and in August. As the period of blooming of the food plant extends over nearly the entire summer, there is abundant time for the second generation of larvæ to come to maturity. Imagoes occur again in June.

Coleophora shaleriella Chambers.

Coleophora shaleriella Chambers, Cin. Quart. Jn. Sci., II, 116, 1875; Can. Ent., X, 110, 1878; Dyar, List N. A. Lep., No. 6043, 1902.

The larva feeds during September and the early part of October upon the interior of the almost ripe seeds of *Polygonum punctatum* Ell., a common smartweed. The larval case is attached near the apex of the triangular seed, which at this time is closely enclosed in the calyx. The larva perforates the calyx and the outer shining black covering of the seed, mining down into the seed and consuming it in large part before migrating to another.

The case is cylindrical, a little bent down at the mouth and gradually tapering to a sharp point at the apex. Three ridges arise about one-third from the apex, defined rather by the flattening of the case between them than by any elevation of the ridges above the general surface; these run together and are lost at the sharp apex of the case. The case itself is spun of pale straw-colored silk, decorated with four or five narrow strips of variable width cut longitudinally from the thin brownish green sheath which clasps the stem opposite the base of the leaf peticle. These strips are attached in a circle just behind the mouth, separated from one another by a narrow space, and extend backwards about four-fifths of the length of the case. They are so closely incorporated with the silken case itself as almost to escape observation, except for the slight differences in color and texture. Seven or eight distinct lines of frass beginning at the point of attachment of these strips run backwards parallel to one another for not over one-fourth the length of the case. Length of case: 10-11 mm.

The cases are very common in spring attached to tree trunks near patches of the food plant. At this time the cases are dull grayish, almost uniformly colored, and the sharp pointed apex is often bent over or broken off.

Imagoes appear from the middle to the end of summer; one bred specimen in my collection emerged August 1st, another August 25th, and I have a captured specimen taken September 13th.

The expanse of all of my specimens is greater than that given by Chambers, viz., 7-16 inch. The smallest measures 13.5 mm., the largest 15 mm. Chambers' description, however, agrees so minutely with the paler specimens of my series that I have no hesitation in referring all to this species. In the darker specimens,

the lines have a decided brownish tinge and are usually more sharply defined, but sometimes there is a tendency for the three lines in the middle of the wing above the fold to coalesce.

Coleophora atromarginata, n. sp.

Basal joint of the antennæ with a long, dense, projecting tuft of yellowish white scales; antennal stalk white conspicuously annulated with dark brown. Palpi yellowish white, with tuft of scales on the second joint. Head and thorax white, with a faint yellow tinge, especially on the patagia.

Fore wings white, longitudinally marked with very distinct brownish ocherous lines. The extreme costal edge, from base to cilia, is of this color. A narrow line starting from the base forks about the basal third. The upper branch, gradually broadening, runs parallel to the costa, reaching the margin just beyond the beginning of the costal cilia; from thence it runs along the base of the cilia to the apex. Its outer edge at the base of the cilia is margined with brown scales. The lower branch, also broadening slightly, extends almost parallel to the fold and reaches the margin just above it; this line also runs along the margin at the base of the cilia, meeting the upper branch at the apex of the wing. The two branches thus enclose between them a streak of the white ground color. There are also two little patches of white scales in the broad part of the upper branch just before the tip of the wing. Beneath the fold there is a narrow streak of the same brownish ocherous color. There is a line of black-tipped scales running through the middle of the costal and apical cilia, which extends just around the apex of the wing and then ends abruptly. Cilia pale ocherous, darker opposite the tip of the wing. Hind wings pale fuscous, cilia tinged with ocherous.

Abdomen brownish ocherous, shading to blackish near the tip, anal tuft white. Legs white, except the tarsi of the hind pair, which are annulated with brown.

Expanse: 10.5 mm.

One specimen bred from a larva on swamp white oak, *Quercus platanoides* (Lam.) Sudw. at Cincinnati. The cases were found in the middle of July, attached to the upper side of the leaf, and the larva, which at this period is nearly full fed, does not mine, but consumes the entire leaf substance with the exception of the lower epidermis.

The case is of the same general character as the cases of *C. tiliaefoliella* Clem. and *C. malivorella* Riley. The entire length of the case in a line from mouth to apex is 8 mm. The case, especially on the sides and in front, spreads out broad and flat at the mouth, so that, when viewed from in front, the diameter at the mouth is almost three times that of the neck just behind it. Viewed from the side, the upper edge is almost straight for a length of about 6 mm., making an obtuse angle with the surface of the leaf to which it is attached. Then, bending at an obtuse angle, it runs backward horizontally for a distance of 3 mm. to the apex, which is rounded and two-valved. The lower edge is constricted at the neck, beyond it almost paralleling the upper edge. On the lower edge, about two-thirds of the distance from the mouth to the obtuse bend, there is a small, blunt, projecting tooth. Attached to the lower edge of the horizontal portion of the case are two crinkled convex flaps, one on each side. These flaps are larger in proportion to the size of the case than the similar flaps on the cases of *C. tiliaefoliella* Clem. and *C. malivorella* Riley. The color of the case in general is blackish, with the flaps and extreme apex dark brown. At the neck, on the under side, two whitish lines meet in a V, and diverge obliquely upward toward the bend of the case, but do not meet on the upper side.

The imago emerged on August 12th of the same year. It is very distinct from any other described species of our fauna; the line of black scales in the costal and apical cilia, and the forked streak on the fore wing are its distinguishing features.

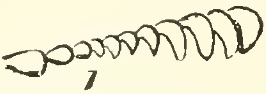
Type in my collection.

A NEW RHIPIDANDRUS (COLEOPTERA) FROM FLORIDA

By Charles Dury, Cincinnati, Ohio

Rhipidandrus fulvomaculatus, **n. sp.**

Piceous black in color, with a large fulvous blotch on each elytron at about the middle. In form, size, and sculpture it resembles the common *Rhipidandrus paradoxus*. The antennæ are quite different from that species, as is also the color of mature specimens. The cut shows the structural difference in antennæ better than it can be described, No. 1 being *fulvomaculatus*, and No.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2 *paradoxus*. The antennæ of *paradoxus* are pale in color, those of *fulvomaculatus* are black with only the terminal joint pale, and legs dark brown with the tarsi pale. Length: 2.6 mm. Fruitland, Fla., July, 1911. Described from specimens received from Mr. Löding, Mobile, Ala., also taken by Prof. Blatchley at Dunedin, Fla., and by myself at West Palm Beach, May, 1913.

Immature specimens are brown in color, and the reddish blotches of elytra faintly indicated. The genus, *Rhipidandrus* Lec (*Eutomus* Lac.), has been removed from the *Cioidæ* to the *Tenebrionidæ*, to which family it seems to be more closely related.

Note — Since the above was written Mr. H. S. Barber, of Washington, D. C., has published a paper, "Notes on Rhipidandri," Proc. Ent. Soc. Wash. Vol. XV, No. 4, 1913, P. 188, in which he gives a chronological list of the literature and describes a n. sp. from Panama. Referring to the above species as "Entomus n. sp."

VOL. XXII. No. 1.

THE JOURNAL

OF THE

Cincinnati Society of Natural History

...Published April, 1916...

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THOMAS BURKITT COLLIER

THOMAS BURKITT COLLIER

Thomas Burkitt Collier, for twenty-one years the Treasurer of The Cincinnati Society of Natural History, was born at Athens, Ohio, September 16, 1848, and died at Cincinnati, May 20, 1915. His father, Daniel Collier, removed from Athens to Cincinnati shortly before the Civil War, and for a generation was prominent in steamboat and insurance circles, and was the second Mayor of Avondale, a village since annexed to Cincinnati. The son was educated in the public schools of Cincinnati, a brief period spent in a local military academy, and at Ohio Wesleyan College at Delaware, Ohio, but did not graduate. After leaving school, he engaged in mercantile pursuits in Cincinnati. During a large part of his business life, he was the head of the firm of Collier, Budd & Co., coal dealers, operating an elevator in Cincinnati, and handling with their fleet of steamboats and barges the output of mines along the upper Kanawha River.

In 1879, he was married to Miss Mary Ella Shaddinger, of Cincinnati, who, with two sons, Lester Dupont Collier and Ashton Collier, survives him.

As early as 1884, he took up photography as a pastime, and for the remainder of his life was a most enthusiastic devotee of the art. He supplied himself at his home with a complete equipment of apparatus and materials and turned off a great deal of work that would have been a credit to any professional studio in the land. He was lavishly generous as a photographer toward the schools, public and private, giving them every commencement season much of his time and skill gratuitously. He became expert in photographing interiors and large outdoor groups. Naturally he found his way early into the Cincinnati Camera Club, the organization of the amateur photographers of the

city, and at once became prominent in its activities. After the Camera Club ceased to exist as a separate organization, and its members united with The Cincinnati Society of Natural History, Mr. Collier for two years served as the Curator of the Photographic Section.

He was elected a member of the Society on January 5, 1886, and in 1890, became a life member. In 1891, he was chosen a member of the Executive Board at large. In 1892, he was elected President, and re-elected in 1893. In 1894, he was elected Treasurer, and was annually re-elected thereafter up to and including the year 1915. In 1908, the Executive Board employed him as Director of the Museum and Clerk of the Board, a position he continued to hold until his death. The records of the Society fail to disclose any individual service which has been so varied or of such long duration. For almost one-half of the life of the Society he served it as Treasurer. Two years as Curator of Photography, one year as member of the Executive Board at large, two years as President, twenty-one years as Treasurer and seven years as Director of the Museum and Clerk of the Board, constitute a record for faithfulness and efficiency which it will be hard ever to equal. Business cares never so engrossed him that he did not have time to lend his presence and counsel to the affairs of the Society. Except when kept away by impaired health, he was never absent from the meetings of the Society or the Executive Board. Promptness to the minute in keeping an appointment was the watchword with him and the rule that he always observed in this regard he exacted of others. After he became the Director of the Museum, which position carried with it that of Custodian of the Society's building, he took great pride in improving as far as possible the physical condition of the Society's property. His own private affairs did not receive more attentive consideration at his hands than did the business of the Society entrusted to his care.

He was a born enthusiast—a striking characteristic of his make-up being the zeal and interest he manifested in

anything which he undertook. In the later years of his life, he became interested in astronomy, and found much intellectual recreation in the study of this subject. His enthusiasm reached out to his friends for he loved them devotedly. If he had an enemy, which is doubtful, he hated him cordially. Rare conversational powers made of him a charming companion and delightful entertainer.

He believed in doing things, was constantly at it, and his friends, this Society included, the beneficiaries of his tireless efforts in their behalf, will look in vain for some one to take his place.

NATURAL HISTORY NOTES OF SOUTHERN ARIZONA

By Charles Dury.

Arizona—That anomalous country, with a fauna and flora so peculiar, and different from other sections of North America; with faunal areas so very unlike each other, even though separated by short vertical distances; where the torrid dry desert of the lowlands is replaced at higher altitudes by a climate most delightful, and with peculiar and beautiful vegetation. A study of the desert flora impresses one with the adaptability of many of these plants to unfavorable conditions, resulting from long periods of heat and dryness. This fierce struggle for existence producing some remarkable modifications of growth. The Giant Cactus, *Cereus giganteus*, the Barrel Cactus, *Echinocactus Wislizeni*, and that amazing Ocatilla *Fouquiera splendens*, always hold me spellbound by their grotesque oddity. Under the influence of the July rains, the Ocatilla puts forth its second yearly crop of soft, green leaves that mask its array of long and needlelike thorns. Here insect life depends on rainfall as much as does plant life. When the rainy season begins in midsummer, the insect fauna appears like magic. Each species seemingly endowed with resistless energy and rapidity of action in the perpetuation of the species. The entomologist who visits this country in the height of the dry season will surely be disappointed. I arrived in Tucson, Arizona, July 7, 1915. The weather was very dry and hot. On the evening of that day I visited the electric street lights in search of insects with no results whatever. There was nothing out. On the afternoon of the 8th, at about 4 p. m., a heavy shower of rain occurred, that lasted over an hour. That evening at 9 p. m., insects were flying around the arc lamps in the streets in swarms. Beetles, bugs and orthoptera whirled around in clouds. The streets beneath the lights were covered with insects and thousands were crushed by vehicles. Large pale crickets were feeding on the bodies on their mangled fellows. The beetles most in evidence

were *Cotalpa, Polyphylla* and *Straetegus*, with a host of smaller species. Automobiles passing under these lights received a shower of insects. In corners and recesses of buildings heaps of insects were piled up. I remained here until July 12th, and every night this deluge of insects continued. On July 12th, I went to the Santa Rita Mountains. a most interesting locality for a naturalist. Some of the canyons on the western side of this range are well watered and covered with fine trees and curious plants. During my stay here a large collection of insects of all orders was made. Of the Coleoptera, or beetles, many interesting species were secured. The plants most prolific in producing beetles were the different forms of cactus. The cactus faunae has been well described by the late Henry G. Hubbard in Psyche and the Proc. Ent. Soc. of Washington, D. C. The large weevil, *Cactophagus validus*, was common, clinging to the Prickly Pear (*Opuntia*). The Tree Cactus *Opuntia versicolor*, is attacked by a Longicorn, *Coenopoeus palmeri*, that causes an exudation of gum, which hardens and forms lumpy black masses on the stem of the plant. The colors of the beetle mimic this blackish exudation and makes them difficult to see. They cling so tightly to the plant that they must be pried off. The needlelike thorns of these plants furnish them good protection. In some huge Barrel Cactus which I found in the proper condition of decay there were swarms of beetles of many species, that feed on the moist, fermenting pulp. The large *Hololepta yucateca* and the smaller *Cacti* and *Vicina* were abundant. A perfectly huge histerid, *Omalodes grossus*, was rare. The very active *Xanthopyga Cacti, Belonuchus Masocharas* and other interesting *Staphylinidae* went rushing about seeking safety in crevices and holes in their efforts to escape. At the base of the plants in the wetter pulp, were quantities of large dipterous larvae. The cacti are the only plants that have much moisture in them, and the moist decaying interior is very attractive to insects. One may travel for miles over sunburned plains and foothills without finding a drop of moisture anywhere.

Approaching one of these Barrel Cactus or "Bisnagas," in a half-decayed condition, one can not see any insect life from the outside, but cut or break it open and the interior will be swarming with insects, mostly beetles, of many species. This is the cactus that is used by travellers from which to obtain water, when caught in these deserts without any. The flavor of the sap is not very pleasant, but is sufficient to supply enough moisture to sustain life in an emergency. Under suitable stones or other cover were clusters of *Discoderus* that were greenish when fresh, but in drying this color faded out in most of the specimens. Color has been made use of as a specific character in this genus in some descriptions, but it is of no value. Specimens of *Neobrotica pleuristicta* were beaten from a bush that bore green pods, containing red beans which are said to be fatal to horses if they eat them. I was unable to learn the name of this plant. The Honey Pod Mesquite *Prosopis velutina*, and Cat's Claw, *Acacia greggi*, when beaten into an umbrella, yielded many species, *Tyndaris* and other *Buprestidae* with Longicorns and Chrysomelidae. July 15.

I noticed a mesquite tree almost defoliated by *Epicauta pardalis*. A few strokes on the limbs brought down a pint of these beetles into the umbrella. Only certain trees seem to be attacked by them. They go in swarms and, after eating up one tree, move to another. At light, at night many good species were taken. *Pseudomorpha* ran over my paper with lightninglike speed. *Listrochelus* and *Phytalus* occurred, though not abundantly, but *Lachnosterna*, *Diplotaxis* and *Anomala* were. Two species of *Aneflus* were common, as was *Mallodon*, and other smaller longicorns. On the flower heads of *Daslerion wheeleri* swarms of *Lycostomus loripes* congregated, and the active, bright-colored *Clerus spinolae* was frequent. On the side of one of these flower heads, I took a large Mantis, purple and green in color. It had three purple blotches on each wing cover. It was chewing a bumblebee, and was the only one I saw of the species. The tribe of grasshoppers were abundant.

The large species called Toad Grasshopper (*Phyrnotctix Magna*) were common. July 14, many pairs taken in couple. They varied much in color, and closely resembled the color of the ground where they lived. Some specimens taken among fragments of disintegrated, rust-colored rock were colored just like the rock, so much so that it was impossible to see them unless they moved. The female is huge in size, the males much smaller. They can not fly, having the wings aborted. This mimicry of color is doubtless a protection from the keen eyes of numerous mocking birds who feed largely on grasshoppers. During July, many of the *Locustidae* and *Acrididae* are mature, though some species are not until later. A few species were of very bright colors, one kind found higher up in the canyons had beautiful blue hind wings. A huge, long-winged grasshopper was powerful in flight and difficult to catch. It is called *Schistocera vaga*. Some of the round holes in the ground were occupied by giant Tarantulas. One monster we dug out at a depth of ten inches made a savage bite at the net handle, but, after that gave up and died quickly in the cyanide jar. The deadly foe of these huge spiders is a wasp called Tarantula Hawk, belonging to the genus *Pepsis*. Some specimens taken were two inches long, with a wing spread of three and one-half inches. Their sting is most formidable, and desperate battles take place between them and these huge spiders, and the wasp generally wins, though not always. The object the wasp has in attacking the spider is to deposit her egg on the body of the paralyzed spider, which serves as food for her young. The spider evidently knows that one thrust of the sting will be fatal, and makes a desperate effort to escape. The peculiar paralyzing and preserving effect of the virus of the wasp's sting is one of nature's marvels, for if the sting killed the spider outright, its body would decompose before the young wasp larva reached maturity. Pouring water into the Tarantula's hole generally brings them to the surface. In turning over logs, some monster centipedes were uncovered. They are very striking

looking fellows, of a rich orange-olive color, with heads and the three posterior segments dark green. When disturbed, they bite savagely. They sometimes come into one's tent and crawl under the blankets and are very disagreeable bedfellows. The ants of Arizona, like those of Texas and New Mexico, are a conspicuous feature of the insect fauna. The different species and modifications are legion. The Agricultural Ant (*Pogonomyrmex*) clears away all vegetation, sometimes for a space thirty feet in diameter around the entrance to its nest. Some very interesting beetles live in the nests of these ants. But, as the ant stings severely, one must not let them touch the skin, for the instant they do, they sting. One that got up my trouser's leg stung me four times in as many seconds. He who digs for Myrmecophilus coleoptera in their nests will have his troubles. In the early Spring and late Fall, the ants are not nearly so aggressive. Mr. McCleary, a ranchman, kills them when they come near his house by placing lumps of fused cyanide at the entrance to their nests, this he moistens with water from time to time. Every ant that touches this cyanide is killed, and they can not go in or out without touching it. He has tried pouring liquid cyanide and bi-sulph. carbon into the nests with only partial success. I saw heaps of dead ants he had killed at the nests he had treated, and not a living ant was to be seen. Some beetles had also been killed by touching this deadly cyanide. This ant is a pest of such great importance in some situations that they must be gotten rid of at any cost. Its sting is most peculiar and painful, and is most quickly relieved by using ammonia on the affected parts. The aggregate area of grass lands denuded and destroyed by these ants in Arizona, New Mexico and Texas must be very great. Another curious ant is a black species of *Pheodole* that lives under stones. Some of them have enormously developed heads and nutcrackerlike jaws. They are said to be the seed crackers of the colony. This species does not sting and is harmless and inoffensive.

A very interesting insect is the Arizona Carpenter Bee, *Xylocopa arizonica*, and its nest is wonderful. I found a Daslerion plant that was dead and had the large, dry flower stalk standing. It was nine feet high. On one side of the stem were some circular holes. Striking the stem a sharp blow caused a buzzing inside that was terrifying. I chopped the stem off and split it open, and thirty mature Carpenter Bees dropped out and went tumbling over the ground. The manner of making this nest was a marvel of skill in selecting the best location and material available for the purpose, and is not excelled by any other bee. The pithy interior of the stem is cleanly excavated and the debris cemented together, used to make the septem between the cells, and in each cell one of these beautiful, shining, blue-black bees was hatched and matured.

Some beautiful Lepidoptera were flying in July. The majestic *Papilio daunus* sailed through the trees and over the tops of the mesquite bushes, once in a while visiting a flower, stopping only for an instant, then taking flight again. The freshly hatched ones were very difficult to catch. Those that had flown for several days being less wary. A number of pretty skippers were darting through the open glades in the woods, the most conspicuous of which was *Achalurus cellus*, which had the habit of darting at every other insect that came near. At moist places in the creek bed, clouds of brilliant blue Lycaenas rose up on being disturbed, fluttering over the spot where they had congregated, only to alight again, when the danger was past. Very few moths came to light. From the great number of larvae seen, July 12 to 24, the imagos must come later. *Anosia berinice*, *Chlorippe leilia*, *Terias mexicana*, with numbers of skippers, satyrids and lycaenids, were all flying in favorable places, though the freshly hatched ones not easy to catch. Some showy and remarkable Hemiptera were taken. One huge species attracted my attention by its bright red and white color in its immature stages. It was several days before the mature form appeared. July 20, while beating mesquite bushes, I

saw a cluster of these bugs in the top of a bush. On knocking them into the umbrella, I found three adults of this large and beautiful species. There were twenty of the larval forms in the cluster. The males have enormously developed posterior legs. *Cicada* were very scarce, only one species was taken. Its note is weak and seldom heard.

The bird fauna of the Santa Ritas is one of the most interesting of North America. At the earliest daybreak their music began, a veritable medley of melody. In the wild, rocky canyons, birds are rather scarce, but around this ranch house, situated as it was, in a dense grove of live oaks and surrounded by thickets of thorny bushes, with an abundance of water, made it an ideal resort for birds. Vermin, such as wild cats, lynx, hawks and other enemies of bird life, were welcomed with a charge of shot by the ranchman.

The white-winged dove was so noisy its cooing was deafening. July 14, I noticed that birds of several species were very much excited and in great commotion in the trees overhead, screaming and chattering at some object high up in a live oak tree under which I sat. A female white-winged dove fluttered to the ground almost at our feet, as though in great distress, quivering her wings and acting as though wounded. She seemed to be trying to entice some enemy away from her nest, telling us as plainly as though she could speak, that her babies were in peril. Scanning the branches of the tree from which she came, I expected to see an owl, but finally discovered a large snake stretched along a limb. A load of shot brought it writhing and twisting to the ground. Noticing a lump in its body, I cut it open and found it had swallowed a young Arizona Hooded Oriole. This snake was five feet long and was called by the ranchman, a bullsnake. When the body of the snake was disposed of, the birds resumed their normal occupations. They were very tame and came close to the cabin door. apparently realizing that they were protected. The ranchman enjoys their company and does not allow them to be

molested. I identified the Band-tailed Pigeon, White-winged Dove, Carolina Dove, Arizona Plumed Quail, Hooded Oriole, Arizona Cardinal (whose flaming livery of scarlet outshone the form we have in Ohio), Texas Cardinal, Mocking Bird, Red-shafted Flicker, Arizona Jay, Canyon Towhee, Crissel Thrasher, Painted Red Start, Crimson Flycatcher, Mountain Mocking Bird, Rufous-backed Humming Bird, and a much larger species that I identified as *Eugenes fulgens* only one seen. At evening, some croaking Ravens came into the live oaks to roost, and after dark, while I was at work catching insects, I heard the curious cry of some Pygmy Owls overhead, although none were seen.

The Herpetologist can find some interesting reptiles in these mountains. The Gila Monster, *Heloderma suspectum*, lives on the mesa and foothills, and is not often seen. July 25, we caught one near the ranch house. It was out on an open sandy spot. On being approached, it opened its mouth and repeatedly darted out its tongue, hissing loudly. There is a legend that its breath is noxious and deadly, but I brought my face close to it, without any ill effect, so concluded this to be a myth. The ranchman told me to kill it, as it was a great robber of ground-nesting birds, eating their eggs. Several hard blows on the head, that would have killed any ordinary animal, only stunned it. Though I supposed it was dead when I left it, expecting to get it later, I found it had revived and made off. The tenacity of life is very great in these reptiles. I am just in receipt of a letter from the ranchman, describing a fight between one of these Helodermas and a rattlesnake, the two having been put in a pit from which they could not escape. "The snake struck the monster fairly, drawing blood. Then the monster got hold of the snake and hung on until the snake was dead. The monster was not harmed." McCleary asks is it known that the Gila Monster is immune to the poison of Rattlesnakes? Aside from Heloderma's habit of feeding on the eggs of ground-nesting birds, I can see no reason for destroying them, as they are certainly the most curious and

interesting reptile in North America. The Arizona snakes are many of them of very pretty species. I saw a number of the smaller non-venomous species, but I did not disturb them. July 24, while taking a walk of eight miles, from one canyon to another, I was caught in a cloudburst. The rain came down in sheets. I opened my collecting umbrella and crouched under a leaning tree, but soon found my pockets were full of water, though I managed to keep my insect specimens fairly dry. When near camp on the way back, I came across some snakes that had evidently been drowned out and seemed to be travelling for higher ground. One large rattlesnake crossing the trail tempted me to drop a a huge rock on its head. These reptiles seemed to be as uncomfortable as I was. The creek beds, usually dry, were raging torrents and large rocks and boulders went rolling and grinding down, propelled by the resistless current. I saw a specimen of a curious little rattlesnake, very small, though adult, killed by a miner. I had previously killed another in Grant County, New Mexico, July 4, 1915.

When I had my light out in the evenings collecting beetles, a small toad came out of a hole in the cabin wall, hopped over to my paper and took up a position near my light. At intervals it would snap up a beetle. When it swallowed a *Cyclocephala* or *Listrochelus*, it was very amusing to watch its expression and see it roll its eyes, turn and twist, and scratch at its sides with its feet, as the victim in its stomach endeavored to get out. One evening I kept count and it devoured eighteen beetles, none smaller than *Diplotaxis*. By midnight it was filled up and retired to its hole between the rocks in the cabin wall. Each evening, when this toad emerged from its hole, it would be flat and thin, but when it retired, it was swelled to aldermanic proportions, so much so that it was with difficulty it could squeeze into its hole. Finally it failed to reappear and I saw it no more. Either the abnormally abundant diet brought by my light was too much for it, or some snake made a meal of it.

The high mountain of southern Arizona, Old Baldy, 9432 feet high, is an easy mountain to ascend, and the view from the top will well repay the effort. The U. S. Department of Forestry has cut a trail to the top, making the ascent both safe and easy. July 23, I found the Ladybug, *Hippodamia convergens*, up there by millions. The ground was covered in places, and they were piled up under the low, stunted shrubbery in heaps. I filled my hat with them in a few scoops of my hands. Many pairs were in couple, and all seemed to be in lively, healthy condition. Down lower on the mountain side none were seen. I could not discover the meaning of this strange migration, unless it was a sort of honeymoon trip that insects, as well as the genus homo, take to some expensive and uncomfortable place. When impregnated, do these beetles descend the mountain to deposit their eggs among the plant lice, which form the food for their young?

TWO NEW BEETLES FROM CINCINNATI, OHIO

By Charles Dury.

Family Trichopterygidae (Ptiliidae)

Genus *Nanosella*—*N. atrocephala*, **n. sp.**

Body elongate, narrow, sub-parallel, testaceous in color, except the head which is shining black when fresh, convex and prominent. Front swollen and projecting. Antennae 11-jointed, with 3-jointed club. Eyes large and coarsely faceted. Prothorax as long as wide, base arcuate, sides broadly feebly rounded. Base wider than apex. Angles not prominent, surface sparsely punctured and with sparse, stiff, recumbent hairs. A transverse groove or impression at base. Scutellum visible and triangular. Elytra at base as wide as prothorax, sub-parallel. tips separately rounded, and nearly three times as long as prothorax. Punctures sparse and hairs as in prothorax. Beneath, prosternum long before coxae. Front coxae large, transverse and contiguous. Middle coxae separated by the produced point of prosteronum. Posterior coxae widely separated and broadly laminate. Under surface finely punctuate and clothed with prostate pale hairs. Eleven specimens taken near Cincinnati, Ohio, July 13, 1914, on the fungus *Poria cinerea* Sch. found growing on the under side of an elm log. Length .50mm. A longer species than *Nanosella fungi*, but much narrower. A remarkable little insect. Cotype in National Museum.

Family Calandridae

Genus Phloeophagus—*Phloeophagus variolatus*, **n. sp.**

Body elongate, sub-cylindrical. Color piceous, shining. Legs and antennae pale. The beak short, thick, continuous with the front. Scrobes short, directed below the eye. A feeble transverse gular groove. Head beneath transversely wrinkled. Antennae stout with 7-jointed funicle. Club oval. Antennae inserted at middle of beak. Eyes very

flat and finely faceted. Head rather finely punctured. Prothorax longer than wide. Sides slightly arcuate. Punctures variolate larger than those of head. Anterior coxae very narrowly separated. Elytra about twice as long as prothorax, and slightly wider at humeri, with coarse quadrate punctures. Interspaces as wide as striae, each with a row of minute punctures sparsely placed. Scutellum small. Body beneath with sparse coarse variolate punctures. Middle coxae more widely separated than anterior ones. Posterior widely separated. Ventral segments five, 1st, 2d and 5th long, 3d and 4th very short. Length 3mm. Thirty-four specimens examined, all taken walking on the trunks of standing dead beech trees in company of *Phloeophagus* minor and *Wallastonia* and *Stenoscelis*, Cincinnati, Ohio, May to July.

A NORTHERN OCCURRENCE OF DENTARIA MULTIFIDA MUHL.

By E. Lucy Braun

In the spring of 1913, the writer found a large patch of *Dentaria multifida* Muhl. (*Dentaria laciniata* var. *multifida* James) growing in a mixed beech woods near Madisonville, a suburb of Cincinnati. This habitat has since been destroyed, but plants from the original habitat are growing in the Emery Bird Reserve, and in the writer's garden.

This plant is not recorded, to my knowledge, as occurring north of the northern boundary of Virginia and Tennessee, and hence is not included in any of the texts dealing with the floras of north-eastern North America. The plants were compared, for verification of identification, with plants in the Lloyd Herbarium, collected on Lookout Mountain, Tenn., by Joseph F. James. The only difference noted is that of size, the more northern plants being only about two-thirds the height of those from Chattanooga.

Although James states (Bot. Gaz. 8:206, 1883 and Jour. Cin. Soc. Nat. Hist. 7:67, 1884) that on Lookout Mountain he found forms intermediate between *D. laciniata* and *D. multifida*, the plants found at Cincinnati were very distinct, and no gradational forms were found.

In this latitude, the plants bloom from the middle to the end of April—two to three weeks later than *D. laciniata*—and the seeds ripen about the first of June. This is a very beautiful plant, much more delicate and attractive than the other species of Dentaria growing here.

Dentaria multifida Muhl. (4-5)

THE CINCINNATIAN SERIES AND ITS BRACHIOPODS IN THE VICINITY OF CINCINNATI

By E. Lucy Braun

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PART I

I. Introduction

The region about Cincinnati is underlain by a series of alternating shales and limestones. This series, to which the name Cincinnatian has been given, is of Upper Ordovician age. The city of Cincinnati lies to the north of the center of a low dome. To the east, north, and west of it, are younger rocks; to the south of it, are older rocks. The quarries about Cincinnati, the steep valley-sides of the Ohio River, and especially the beds of the smaller valleys

present numerous exposures of all but the lowest beds of the series. Fossils are exceedingly abundant at many horizons, and they are as a rule very well preserved. The soils of this region are to a large extent derived from the decay of the bed-rocks, the limestones yielding a much more fertile soil than the shales. Glacial and loess deposits cover a considerable portion of the area, modifying the character of the soil and often concealing the bed-rock.

The present paper is a study of the rocks of the Cincinnatian series in the vicinity of Cincinnati, and of the brachiopods of this series—a class of fossils more abundant and better represented than any other, except the bryozoans. The discussion of the rocks is based on the literature of the Cincinnatian series and on field observations made by the writer through a period of several years. In the work on the brachiopods, the literature and all available specimens in the Museum of the University of Cincinnati were studied. The bibliography of each species is as nearly complete as possible. In the treatment of the different species, the original description (if available) is given except where some later one was considered better. This is followed by a discussion of the distinctive characters and notes on the occurrence and abundance at Cincinnati.

The paper was prepared in 1911 and 1912 in partial fulfillment of the degree of Master of Arts in the Department of Geology of the University of Cincinnati. It is a pleasure to acknowledge to Professor J. Ernest Carman my appreciation of his many helpful suggestions during the progress of the work.

II. Stratigraphy

A. Lithology of the Cincinnatian Series

The rocks of the Cincinnatian series are made up of thin beds of shale and limestone. The shale beds vary in thickness from a few inches to several feet; the limestone strata from a fraction of an inch to eight or twelve inches. The

proportions vary in different formations, but the general lithological characters are quite uniform throughout the series. The shales are blue and calcareous, thin-bedded, and poorly consolidated. In place, they are firm and compact, but soon crumble on exposure to weathering. Although in general, the shale contains a rather poor fauna, specimens of some of our rarer fossils which are seldom found in limestone strata, have been found beautifully preserved in the shale.

The Cincinnatian series is divided on lithological and faunal grounds into five formations, each of which is again subdivided, as shown in the following table. The classification used here follows Bassler for the Eden, Fairview, and McMillan formations, and Cumings for the Richmond.

	Richmond[*]	Elkhorn	
		Whitewater	
		Saluda	
		Liberty	
		Waynesville	
		Arnheim	Oregonia
			Sunset
Cincinnatian..	McMillan[†]	Mt. Auburn	
		Corryville	
		Bellevue	
	Fairview[†]	Fairmount	
		Mt. Hope	
	Eden[†]	McMicken	
		Southgate	
		Economy	
	Utica......	Fulton[‡]	

*Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 621.

†Bassler: U. S. Nat. Mus., Bull. 92, 1915, vol. 2, pl. 2.

‡For the use of this term see Bassler: Proc. U. S. Nat. Mus. xxx, No. 1442, 1906, pp. 8, 9; Foerste: Science, N. S., vol. 22, 1905, pp. 150, 151; Ulrich: Bull. G. S. A., vol. 22, 1911, pp. 296, 297.

1. *Utica.*—The name Eden was proposed by Orton in 1873* for a succession of alternating shale and limestone layers comprising about 250 feet of strata at the base of the Cincinnatian series. In 1897, Winchell and Ulrich† replaced this term by Utica, believing this formation to be the equivalent of the New York Utica. The five feet of strata at the base of the Eden, as defined by Otron, contain *Triarthrus becki*, which is characteristic of the New York Utica. The major part of what Winchell and Ulrich called Utica does not contain fossils characteristic of the true Utica, and is no longer correlated with the Utica, but is now known as Eden. The lower five feet of strata are referred by Bassler‡ to the Utica formation, and given the name Fulton, from the type locality—Fulton, in the East End of Cincinnati. He describes the rocks of the Fulton as "dark gray or drab-colored shales which contrast very distinctly with the overlying Eden shales."§ This formation, which outcrops at 45 to 50 feet above low water of the Ohio at Cincinnati (432 ft. A. T.), is the oldest formation of the Cincinnatian. It is underlain by Trenton,‖ the oldest rock outcropping in the Cincinnati region.

2. *Eden.*—The Eden at Cincinnati is approximately 230 feet thick, and is made up of a series of thin-bedded, calcareous shales, interrupted at intervals of several feet by limestone strata varying in thickness from a fraction of an inch to six or eight inches. The formation is characterized by certain fossils which are restricted to it, or which occur abundantly in it. Among these are *Climacograptus typicalis*, *Heterocrinus heterodactylus*, *Callopora onealli sigillarioides*, *Dalmanella multisecta*, and *Plectambonites sericeus*. Besides

*Orton: Geol. Surv. Ohio, vol. 1, pt. I. 1873, p. 372.

†Winchell and Ulrich: Geol. Nat. Hist. Surv. Minn., vol. 3, pt. 2, 1897.

‡Bassler: Proc. U. S. Nat. Mus., vol. 30, No. 1442, 1906, p. 9.

§Bassler: loc. cit., p. 8.

‖The strata outcropping along the Ohio River bank at West Covington, Ft. Thomas, and Pt. Pleasant, which have been usually correlated with the Trenton of New York, have been shown by J. M. Nickles (Ky. Geol. Surv., bull. 5, 1905, p. 18) to be continuous with the Winchester of central Kentucky. He considers them to be of Cincinnatian, rather than Mohawkian age. Bassler (U. S. Nat. Mus. Bull. 92, 1915, pl. 2) however, refers them to the Mohawkian.

these fossils, which may be considered as characteristic of the Eden as a whole, there are certain other fossils, which are characteristic of one or more of its members.

The members of the Eden are: lower or Economy (50 ft.), middle or Southgate (120 ft.), and upper or McMicken (60 ft.). These members are characterized by certain Bryozoa:* the Economy by *Aspidopora newberryi*; the Southgate by *Batostoma jamesi*; the McMicken by *Dekayella ulrichi*. Lithological distinctions between these divisions are not clearly marked. The Eden is a formation of much greater uniformity than any of the succeeding formations.

Besides the typieal bryozoan of each member, other fossils which are easily recognized, but not as uniformly present, may be mentioned. In the Economy may be found: *Dalmanella emacerata*, *Leptaena rhomboidalis gibbosa*, *Pholidops cincinnatiensis*, *Plectambonites plicatellus*, and *Trinucleus concentricus*. The Southgate contains a more meager fauna than the Economy and is not sharply differentiated from the beds above or below it. *Dalmanella emacerata*, *Pholidops cincinnatiensis*, and *Trinucleus concentricus* are here also, and *Rafinesquina squamula*, which does not oecur again below the Fairmount (see table, Part II), is occasionally present. The McMicken contains a rieh bryozoan fauna, and but few representatives of the other classes.

Exposures of the Eden around Cincinnati are not common. On Elberon Ave. and on Straight St. are good exposures of the higher beds; the lower strata are exposed only in a few stream beds near the river level.

About 210 to 220 feet above the base of the Eden is a prominent horizon marked by two massive limestone strata separated by about eight or ten feet of shale. The lower limestone stratum is 5 to 8 inches thick, and contains few

*Nickles: Jour. Cin. Soc. Nat. Hist., vol. 20, 1902, p. 69.

fossils. The upper is 8 to 16 inches thick, and its upper surface is usually well covered with *Dalmanella multisecta*. A few inches of the shale just beneath the upper stratum is often almost entirely composed of the shells of this brachiopod. In places, the upper three feet or more of the shale bed is largely limestone, in which case this becomes a prominent limestone horizon. The most marked spring horizon of the region is just beneath the lower limestone stratum. Above this stratum, the rocks are porous, allowing the downward passage of ground-water; below, they are quite impervious, necessitating a lateral movement of ground-water. This results in seepage at many places along the outcrop of the upper shale layers, which often is sufficiently concentrated to form permanent springs. The upper limestone stratum, which is the highest horizon containing *Dalmanella multisecta*, is regarded as the top of the Eden.

3. *Fairview and McMillan* (*Maysville*).—Until recently, the rocks of the Fairview and McMillan formations were grouped in one formation, the Maysville, which was subdivided into five members. In both the Fairview and McMillan, alternation of shale and limestone is the most prominent characteristic, more prominent even than in the Eden. The limestone totals about thirty per cent of the thickness; and strata six inches thick are common. The shale of the Fairview and McMillan is often of a lighter blue color than that of the Eden, and much of it is of a coarser texture, and less compact; the limestone, although always impure, is more compact and crystalline here than at any horizon of the Eden.

Fossils are much more abundant in these formations than in the Eden. The surfaces of many of the layers of crystalline limestone are almost completely covered with fossils. Throughout these formations, brachiopods and bryozoans are by far the more numerous fossils, while all the other phyla of invertebrates with the possible exception of the Protozoa, are represented. A number of species are per-

sistent throughout both the Fairview and McMillan; among them are *Lepidodiscus cincinnatiensis*, *Hebertella sinuata*, and *Platystrophia laticosta*. Certain genera are characteristic of the two formations as a whole. Platystrophia, which is rare in the Eden,* is very abundant and characteristic; Plectorthis is, with the exception of a single species, *P. plicatella*, restricted at Cincinnati to these formations; and Zygospira and Refinesquina, although found quite frequently in the Eden and Richmond, are most abundant in the Fairview and McMillan. Cyclonema, Lophospira and Byssonchia are also common.

The Fairview is divided into two, and the McMillan into three members, based mainly on faunal content. The members differ considerably in lithological character.

Mt. Hope.—The Mt. Hope, named from its typical exposure on Mt. Hope Road near the foot of Price Hill, where the entire member is beautifully exposed, contains about seventy-five per cent of shale. It resembles the Eden, but the proportion of limestone is considerably greater. As exposed on Straight St., west of the University, the Mt. Hope has a thickness of about 50 feet. The type fossil is *Amplexopora septosa*.† A single stratum containing *Strophomena planoconvexa* marks the contact between the Mt. Hope and the next higher member, the Fairmount.‡ On most exposures, the contact is difficult to locate, as this fossil is not always present.

Fairmount.—In the Fairmount limestone forms about thirty-five per cent of the total thickness. About half of this is suitable for building stone, and it is the limestone of this division which is most commonly quarried in the vicinity of Cincinnati. The Fairmount is the highest division exposed on many of the lower hills about Cincinnati, as at Fairmount, Hyde Park, and Avondale. It is also the

*Nickles states, Ky. Geol. Surv. Bull. 5, 1905, p. 32: "No Platystrophia has been noted in the Eden," but a few have been found in the Eden at Cincinnati.

†Nickles: Jour. Cin. Soc. Nat. Hist., vol. 20, 1902, p. 76.

‡Nickles: loc. cit., p. 77.

highest bed-rock on the hills back of Newport and Covington. On Straight St. where a good section is exposed, this division is about 60 feet thick. While fossils are less abundant in this member than either above or below, the number of species represented is far greater, and the specimens are better preserved. The bryozoan *Dekayia aspera*,* is the type fossil of this member, while *Glyptocrinus decadactylus*, *Callopora dallei*, *Constellaria constellata*, *Platystrophia crassa*, *Modiolopsis modiolaris*, *Cyclonema mediale*, and *Lophospira ampla* are characteristic.

Bellevue.—The lowest member of the McMillan formation is the Bellevue, a division lithologically and faunally different from the underlying and overlying strata. It has a thickness of only 20 feet. The lower 15 feet is composed almost wholly of limestone which is made up largely of a frondlike bryozoan, *Monticulipora molesta*. This horizon is more resistant than the upper part of the Fairmount on which it rests, so that it stands out prominently on the faces of many of the bluffs around Cincinnati. The upper 5 feet of the Bellevue is composed of thin-bedded shales and shaly limestones. These shaly limestone beds are made up almost entirely of single valves of *Rafinesquina alternata fracta*, with clay partings between the shells. On weathering, the clay partings break down leaving a jumbled mass of poorly preserved shells. This horizon, known as the "fracta zone," is one of the most easily recognized horizons of the entire Maysville. It is less resistant than the lower part of the Bellevue and usually forms a steep slope at the top of the projecting cliff. The type fossil of the Bellevue, *Monticulipora molesta*, is present, although not as abundant as in the lower fifteen feet. *Platystrophia laticosta* is common throughout the "fracta zone," and *Hebertella sinuata*, *Rafinesquina alternata*, and a number of molluscs are abundant in the lower part of this horizon.

Corryville.—The Corryville member of the McMillan, which is 60 feet thick, includes a series of thin limestones

*Nickles: loc. cit., p. 77.

and yellowish shales. Of itself, it is not a distinctive horizon. It is only because of its marked contrast with underlying and overlying members of the McMillan formation, that the Corryville is easily recognized. In the field, it is usually identified by means of its position with relation to other members, or by means of the characteristic bryozoan of the member, *Chiloporella nicholsoni.** The Corryville beds are exposed on the higher hills around Cincinnati. Fossils are abundant: *Platystrophia lynx* is quite large; pelecypods, *Anomalodonta* and *Byssonchia*, are plentiful; and the bryozoan, *Callopora ramosa*, is very abundant and well preserved.

Mt. Auburn.—The Mt. Auburn is composed of a nodular calcareous shale or shaly limestone, 20 feet thick. The type fossil of this member is the large gerontic form of *Platystrophia lynx*. This is especially abundant throughout the lower 5 to 12 feet, and may be found throughout the entire member. Other fossils are not abundant. This member is represented at Cincinnati only by its basal part, which is the highest bed-rock on several of the highest hilltops, as at Fairview Heights (Clifton Ave. and McMillan St.), Price Hill, and Westwood. The Mt. Auburn is the highest division of the McMillan, since it is now known that the overlying Arnheim (Warren), which was formerly placed in the Maysville should, because of its faunal relations, be classed as basal Richmond.

4. *Richmond.*†—With the exception of the lower strata of the Arnheim, the Richmond formation is not found nearer than about thirty miles to the east, north, and west of Cincinnati. To the south, it is even farther removed, because the center of the Cincinnati anticline is to the south of Cincinnati, in Jessamine Co., Ky. At certain horizons, the Richmond formation resembles the Eden more

*Nickles: Jour Cin. Soc. Nat. Hist., vol. 20, 1902, p. 83.

†The discussion of the Richmond formation is taken largely from Cumings' paper, "The Stratigraphy and Paleontology of the Cincinnati Series in Indiana," Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907; and Nickles, "Richmond Group in Ohio and Indiana," Amer. Geol. xxxii, 1903, pp. 202-214.

than it does the Fairview or McMillan, for it is in general a shale formation. In one division, the Liberty, the limestone is however more massive and more evenly bedded than the limestone of the Fairview and McMillan formations at Cincinnati. Faunally the Richmond is more closely related to the Eden, representing a return to conditions existing during the Eden stage. The presence of corals in this formation is a distinctive feature. Columnaria, Tetradium, Streptelasma and Protarea, are common. The Richmond formation is divided into six members.

Arnheim.—The Arnheim is 80 feet thick and has been divided by Foerste into a lower unfossiliferous division, the Sunset, and an upper richly fossiliferous division, the Oregonia.* The basal part is exposed in a cut on the C. & O. Ry. about one mile south-west of Cheviot. This is the nearest exposure to Cincinnati. *Homotrypa bassleri* is given by Nickles, (loc. cit.) as the type fossil of the division.

Dinorthis retrorsa, which has a very restricted vertical range occurs 35 feet below the top. *Leptaena rhomboidalis*, (Richmond form), *Rhynchotrema dentata*, *Streptelasma*, and *Columnaria*, indicate the advent of a Richmond fauna, and unite this division more closely with the overlying than with the underlying strata.

Waynesville.—Lithologically the Waynesville, (the lower Richmond of Nickles), is largely clay or clay shale of an intense blue color, with a few thin limestone layers, 2 to 5 inches thick. It is characterized by the presence of *Dalmanella meeki* in great abundance throughout the zone. *Calymene callicephala* is abundant, and *Leptaena rhomboidalis*, which is present near the top of the division, extends upward into the Liberty.

Liberty.—The Liberty is composed largely of limestone beds, which sometimes reach a thickness of 8 to 12 inches but average about three inches. The limestone, although

*Foerste: Ohio Naturalist, vol. 12, No. 1, Jan. 1912.

forming the predominating rock of the division, is interbedded with thin layers of shale. The base of the Liberty is marked by the first appearance of *Hebertella insculpta. Strophonema planumbona,** from which the Liberty is called the Strophonema zone, *Rhynchotrema capax, Plectambonites sericeus, Bythopora meeki* and *Rhombotrypa quadrata* are present in large numbers. The upper layers contain fewer fossils, and in places become argillaceous and arenaceous.

Saluda.—The Saluda division is even more markedly argillaceous or arenaceous than the upper layers of the Liberty. The typical exposure of this division is at Madison, Indiana, where it is chiefly a sandy limestone, or calcareous sandstone. Northward, it becomes more calcareous, and coarse sediments are lacking. At Richmond, Indiana, it is represented by only a few feet of massive limestone. On the east side of the Cincinnati anticline, the Saluda is chiefly a shale horizon. In the southern area of its outcrop in Indiana, ripple marks and sun cracks are common in the more shaly layers. Reef building corals, *Tetradium minus* and *Columnaria alveolata*, are very abundant. Two coral reefs are present, separated from each other by several feet of argillaceous rock. In the southern portion of the area both are composed of Columnaria. If these are traced northward, the upper is seen to be replaced by Tetradium. The Tetradium reef is much more persistent than the Columnaria reef, but is absent at Richmond, Ind. Both corals become much less abundant in the northern part of the area. At Madison, Ind., the Saluda is separated from the Silurian by 20 feet of mottled limestone, which represents only the lower portion of the Whitewater. Cumings† interprets the Saluda as a shore deposit related to the Whitewater and Elkhorn, which overlie the thin calcareous representative of the Saluda in the more northern sections, as at Liberty and Richmond, Indiana. Many authors consider the White-

*S. planumbona (Hall). See Nickles: Am. Geol. xxxii, 1903, pp. 214-217.

†Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 673.

water to be the immediate successor of the Liberty, not having recognized the thin, more northern representative of the Saluda. The Saluda contains a very poor fauna, except towards the top, where certain brachiopods and bryozoans which are common in the Whitewater, begin to appear.

Whitewater.—The Whitewater is composed of nodular and concretionary shales and impure limestones, often of a brownish or yellowish color. It contains a much richer fauna than the Saluda. The predominate fossils are bryozoans, which are very abundant. *Rhynchotrema capax* which is common in the lower part of the member is replaced by *Rhynchotrema dentatum* near the top. *Platystrophia acutilirata* and *Hebertella occidentalis* are characteristic fossils.

Elkhorn.—The upper 50 feet of the Richmond contain a fauna very different from that of the preceding Whitewater, and are designated by Cumings as the Elkhorn division of the Richmond.* The lower 15 feet of this member is shale, containing few fossils. The fauna of the Elkhorn is made up of recurring Fairview and McMillan types, *Hebertella sinuata*, *Platystrophia laticosta*, and other species with their closest relatives in the Maysville. The division is characterized by a form of *Platystrophia lynx* known as *P. lynx moritura*.

B. Structural Features of the Cincinnatian

The structural features of the Cincinnatian are of two kinds: original features, those which show conditions existing during the epoch: and secondary features, those which indicate subsequent events.

1. *Original.*—Under the first class of structural features may be considered wave-marks or "giant-ripples," mud-balls, sun-cracks or mud-cracks, and worm borings

*Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 678.

Wave-marks.—Many limestone layers of the Eden and Fairview formations have undulating upper surfaces and plane lower surfaces. Such undulations are wave-marks or the so-called "giant-ripples." The crests and troughs of the wave-marks are in general approximately parallel. The distance from crest to crest varies from two to four feet. The thicknesses of the wave-marked strata vary from one to three inches in the trough, to three to six inches at the crest. The material of which these wave-marked limestones are composed is, as far as has been observed, always fragmental. The wave-marked strata are usually overlain by shale, which is sometimes laminated, but more often homogeneous. Where laminated, the laminae usually conform to the wave surface of the limestone stratum, the waves gradually dying out before the next bedding plane is reached.

The direction of the wave-marks is not uniform. In some cases waves have been observed to trend at almost right angles to those of other strata but a few inches above or below. Of fifteen wave-marked strata observed, ten have the crests and troughs extending in directions included in the northeast-southwest quarter of the compass, and five have the crests and troughs extending in a general northwest-southeast direction. That is, in general there seems to be a division into two groups, (1) those with NE-SW trend, and (2) those with NW-SE trend. One slope of the wave-marks is steeper than the other. Five examples of the first group (NE-SW) were observed for position of steeper slope, and one of the second group (NW-SE). In the first group the steeper side was toward the southeast; in the second, to the northeast. This indicates that the waves moved in a southeasterly direction when forming those wave-marks having a NE-SW trend, and in a northeasterly direction when forming those with NW-SE trend. The southeasterly movement appears to have been the more general.

The following table records observed data for sixteen wave-marked strata.

Altitude of stratum	Horizon	Direction of wave-marks	Distance, crest to crest	Height of crest above trough	Steeper side
450′	Trenton	....	4′	4-6″	....
530′	Eden	N70°W-S70°E	3′	4″	....
530′	Eden	N-S	2′ 6″	2″	....
530′	Eden	N70°W-S70°E	2′	1″	......
540′	Eden	NW-SE	2′	2″	......
565′	Eden	N-S	2′ 8″	3″	....
565′	Eden	NW-SE	2′ 6″	2-2.5″	....
661′	Eden	N27°E-S27°W	2-3′	3″	SE
665′	Eden	N80°E-S80°W	4′	1.5″	S
.	Fairview	N55°E-S55°W	3′	1.5″	SE
.	Fairview	N80°E-S80°W	. . .	....	. .
715′	Fairview	N12°E-S12°W	1½-2′	.....	....
730′	Fairview	N45°E-S45°W	2-3′	2.5″	SE
731′	Fairview	N50°W-S50°E	2′ 3″-2′ 6″	....	NE
760′	Fairview	N45°E-S45°W	2′ 9″	2.5″	SE
760′	Fairview	N20°E-S20°W	1′ 8″	... .	.. .

These waved-strata indicate that the water was not too deep for the sediments to be moved by the more powerful waves, and the fragmental nature of the material of the strata shows that it had been much worked over before it was finally left with a waved surface, to be covered with a deposit of mud and thus preserved. None of these wave-marked strata have as yet been shown to be continuous over any considerable area, but they have been observed in all parts of the area, and at various horizons in the Eden and Fairview formations. They may have been formed either in shallow water near a shore line, or in shoal water which was independent of a shore line. Many of the wave-marks trend approximately in the same direction (NE-SW), indicating the possible existence of a land mass not far distant. There are, however, a few prominent exceptions to these in strata but a few inches above or below, whose directions could not have been controlled by the same shore line. It therefore seems more probable to the writer that they were formed in shoal water, and that their direction was controlled by the wind.

Mud-balls.—In some limestone layers there are rounded masses of shaly material, varying in size from one to three inches in diameter. The material is very different from that of the containing stratum, being best shown when in limestone made up of comminuted shells. Upon weathering these masses are in some cases released from the containing limestone and may be found free on the surface. These masses are interpreted as fossil mud-balls. They were probably formed from irregular masses of mud broken off by waves from mud layers nearby or just beneath the newly forming sediments. After being worn and rounded by the waves the mud-balls were dropped and became imbedded in the finer sediment being deposited.

Sun-cracks.—Sun-cracks are not known to exist in the Eden or Maysville formations, but are quite prominent in some of the shale layers of the Saluda member of the Richmond. They indicate extremely shallow water conditions, with short emergences, allowing the mud to dry partially and crack, before being covered with another layer of sediment.

Worm borings.—Many of the more shaly strata are curiously marked with what are thought to be worm borings. These worm borings are of two types:—(1) those extending along the bedding planes, and (2) those passing into and through the beds. The first type probably represents the path of worms crawling along the sea-bottom; the second, of worms burrowing into the mud.

2. *Secondary.*—Under this class of structural features are those indicating subsequent events. They include the Cincinnati anticline, local folds and faults, and joint cracks.

The Cincinnati anticline.—The strata of the Cincinnatian series at Cincinnati appear to be horizontal. They are, however, part of a low broad anticline extending from Nashville, Tenn., northward through Kentucky, to Cincinnati. Near Cincinnati the anticline divides into two branches, the one extending northwestward toward Chicago, the other northward through western Ohio. This anticline

is divisible into two domes—the Nashville dome of Tennessee and the Jessamine dome,* culminating in Jessamine Co., Ky. The whole uplift is known as the Cincinnati anticline.

Local folds and faults.—The rocks of the Eden and probably of the Maysville are locally distorted by low anticlines, which are only a few feet across. Thrust faults are in many cases associated with these folds, the fault plane running in the direction of the axis of the anticline. No faults are known to exist in this region except in connection with anticlines. These faults have a throw of several inches and a hade of 25° to 35°. There appears to be no accordance of direction of the axes of these folds and faults.

Thirteen small folds and faults have been noted by the writer within the area of the Cincinnati quadrangle. Of these eight are at an altitude of from 620 to 640 feet A. T.† or from 30 to 50 feet below the Eden-Fairview contact, that is, are found in the McMicken member of the Eden. Five of the observed folds affect the shale bed and limestone strata just beneath the Eden-Fairview contact.

In all the folds and faults of the lower series (those of the McMicken), but a small section is exposed, so that it is not known to what extent the distortion affects the strata vertically. All are in stream beds, and while cross sections of the folds or combined folds and faults are usually exposed in stream banks, it appears that the axes trend in the same general direction as the stream valleys in which the folds are found. One faulted anticline which was observed‡ is exposed in the undercut bank of a meander curve. The fault where exposed in the stream bank has a hade of 30° and throw of six inches. Upstream, the fault dies out in a low almost symmetrical anticline, whose sides have a dip of almost 10°. The fold extends only about 25 feet in the same direction before disappearing entirely. Its extent in the other direction is not shown.

*Matson: U. S. Geol. Surv. Water Supply Paper 233, 1909, p. 26.

†These altitudes are judged from the topographic map of the Cincinnati quadrangle.

‡On the west branch of Sycamore creek, north central part of section 22, Symmes township.

The folding of strata just below the Eden-Fairview contact is usually of a very irregular nature, thus differing from the folding at the lower horizon, which is much more regular. At this higher horizon the axes are parallel to the stream valleys. Only two or three feet vertically are affected the distortion seldom extending upward to the Dalmanella layer.

Two possible explanations of these folds and faults in the Eden shales present themselves: (1) lateral compression due to dynamic action during the formation of the Cincinnati anticline; (2) buckling due to removal of load in stream valleys in recent times.* The observed folds seem to be separable into two groups—or possibly three groups if those reported from the Maysville be considered—differing in regularity of folding and extent of distortion. The first group includes those folds of the Eden shale (McMicken) found at horizons 30 to 50 feet below the Eden-Fairview contact. The axes of these folds are apparently somewhat parallel to the stream valleys (or to the general trend of the valleys), and are without accordance of direction. These folds are usually quite regular and sometimes almost symmetrical. The second group includes those folds found at the top of the Eden, with their axes parallel to the stream valleys. These are always very irregular, and the strata seem to be crushed and broken rather than distinctly and regularly folded.

Considering first the folds and faults of the lower series (McMicken), uniformity of horizon would favor the first explanation, as it would seem probable that these folds at a common horizon, should have a common origin. Lack of accordance of direction of axes is opposed to it, as lateral compression, working over the area through which these folds are distributed, would produce a general parallelism of axes. Their existence in stream valleys would suggest the second explanation, affecting possibly an inherently

*For a known example of buckling due to a similar cause, see Bull. Geol. Soc. Amer. vol., 20, p. 625.

weak horizon, a fold occurring whenever this horizon is properly situated topographically. Their direction, more or less parallel to stream valleys is favorable to the hypothesis that they have resulted from buckling due to removal of load in the valley.

The second group, at the top of the Eden, seems to be adequately explained by the hypothesis of buckling. Here, the axes are parallel to the stream valleys. In all cases where folding exists at this horizon, the stream bed is suddenly cut deeper just beneath the Eden-Fairview contact. This horizon lies just beneath a formation which contains a rather large proportion of limestone and is therefore stronger than the shale beneath. When this support is removed buckling may occur, as the shales cannot withstand the downward force on either side.

Joint cracks.—In the Cincinnati region the rocks are affected by two very persistent systems of vertical joints, having general east-west and north-south directions. These joints are not uniformly spaced, varying usually from about one to three feet apart. Both systems extend far beyond the Cincinnati region, as indicated by the following statement from Matson: "In the Blue Grass region there are two well-developed systems of vertical joints at approximately right angles to each other. These joints have general north-south and east-west directions and are apparently very persistent."* It is probable that these two systems of joints are coextensive with the Cincinnati anticline. They affect both shales and limestones, but are more prominent in the limestones. These joints are taken advantage of in quarrying the limestone strata, the joints forming easy fracture planes often doing away with the necessity of blasting. Weathering first takes place along these joint planes, manifesting itself in the yellow oxidized borders of the joint blocks. The joint cracks greatly facilitate the circulation of ground-water, and become much enlarged by solution in the purer limestone strata.

*Matson: U. S. Geol. Surv. Water Supply Paper 233, 1909, p. 28.

A number of limestone sinks are known in the Cincinnati quadrangle in places immediately underlain by the Bellevue, which contains some of the purest limestone strata of the series. They probably owe their existence to the falling in of the roofs of caverns which were formed by the solution of the Bellevue limestone.

III. Geologic and Physiographic History

A. Paleozoic Era

1. *Cincinnatian epoch.*—During the Cincinnatian epoch the interior of the continent was a vast epicontinental sea, with land to the east, north, and west. Toward the close of the Mohawkian epoch the sea became shallow enough to affect the character of the sediments. The Winchester and Lexington limestones (Mohawkian) of central Kentucky and the Bromley and Pt. Pleasant (Trenton) of northern Kentucky and southwestern Ohio, which contain upward an increasing amount of shale, give evidences of the shallowing of the epicontinental sea in the Cincinnati region. The wave-marked limestone layers composed of fragmental material and the mud-balls of the Pt. Pleasant indicate that the sea had become quite shallow. A slight disconformity exists at the top of the Pt. Pleasant, pointing to a short emergence of this area at that time.

Eden stage.—Throughout the Eden stage the sea remained quite shallow and a large part of the material deposited was mud. The mud-balls and wave-marked limestone layers of this formation previously described also indicate shallow water deposition. The amount of material deposited (230 feet) was far greater than that of the two subsequent stages, and almost equal to that of the Richmond. The life of the Eden stage was meager for the muddy waters were unfavorable to abundant life. Bryozoans, though not abundant, were fairly well represented, and trilobites (Calymene and Isotelus) and pelecypods (Byssonchia) were not uncommon.

Maysville stage. During the Maysville stage, the supply of mud was lessened, as is shown by the increased proportion of limestone upward in the formation. It is not known whether this clearing of the seas was due to an actual diminution in the amount of mud supplied, or to a deepening of the sea which would reduce the amount of terrigenous material brought to this place. But we do know that at times the sea was quite shallow, for in the Fairmount member where limestone is relatively more abundant than at any lower horizon in the Cincinnatian, there are several waved limestone strata. As these are composed largely of fragmental material, they could not have been deposited at a depth greater than that at which such material can be agitated by the waves. The Maysville stage was a time favorable to the existence of abundant animal life, and especially to such forms as brachiopods and bryozoans which inhabited clear waters.

Richmond stage.—During the Richmond stage, conditions changed frequently, as is shown by the alternation in the character of the rock. These varying conditions were probably produced by epeirogenic movements. The Arnheim (basal .Richmond) was a time of deposition of shaly limestone and of shale. The change from clear water conditions of the McMillan stage to the muddy waters of Arnheim time affected the life of the seas very strongly as is shown by the scarcity of fossils in the lower division of the Arnheim (Sunset). Later in the Arnheim time (Oregonia), life became abundant, but the species and even the genera were largely different from those of the previous stage. The Arnheim time was transitional between the McMillan and the Richmond stages. Muddy water conditions inaugurated during the Arnheim time prevailed during the deposition of the Waynesville, and in accord with this, species closely related to those of the previous muddy water stage, the Eden, appeared, such as *Dalmanella meeki*, *Leptaena rhomboidalis*, and many bryozoans. Following the Waynesville time the seas again cleared, inaugurating

the most pronounced limestone making age of the entire Cincinnatian, the Liberty. This was characterized by an abundance of brachiopods whose nearest relatives lived in former limestone making epochs—Trenton and Maysville. After 35 feet of calcareous material had accumulated, the clear seas were suddenly terminated by a return to muddy waters, and an extensive shoaling of the sea. It is probable that at the time of the formation of the coral reefs of the Saluda and the deposition of its coarse terrigenous sediments, a part of the Cincinnati anticline had emerged, and that the shore features of the Saluda were caused by the presence of this land. Some of the shaly strata of the Saluda bear sun-cracks, showing that a part of the area occupied by these rocks was occasionally even above the surface of the sea. Terrigenous material was still supplied during the deposition of the Whitewater and the Elkhorn, but it was less coarse than that of the Saluda. At Madison, Ind., the highest beds of the Richmond formation are absent and the Clinton rests unconformably upon the lower portion of the Whitewater. This shows that the area of the land did not remain constant, but at times diminished in size permitting the overlap of younger sediments.

As has been indicated, the Richmond stage was a time of epeirogenic movements in the eastern interior of the continent. The sediments of the Medinan series of New York indicate that this epoch was a time of epeirogenic movements in the east. The Richmond is a formation known only in the interior basin; the Medina and Oneida formations of the Medinan of New York are known only in the Appalachian district. Both represent a time of changing depths of seas, and shifting land masses. Because of the peculiarities of their distribution, the movements accompanying their deposition, and the character of their sediments, a question has arisen as to the possible equivalence of the Richmond and basal Medinan formations, and if they are equivalent, to what system, the Ordovician or

Silurian, they belong. Cumings* considers that the movements of the Richmond and Medina stages were related, and that the Richmond is equivalent to a part of the Medina. Bassler† places the Richmond formation in the Silurian system, evidently in accordance with this idea of its contemporaneity with the eastern formations.

2. *Silurian period.*—That an emergence of the Cincinnati anticline occurred late in the Richmond or early in the Silurian is further indicated by the different nature of the later Silurian formations to the east and west of the anticline. The Clinton of Ohio and Indiana is very similar faunally and lithologically‡ thus precluding the existence of any extensive land mass at that time, but the Waldron of Indiana§ and Tennessee is not represented by any similar formation in the area to the east of the anticline, which might be interpreted by assuming that a land barrier existed between these two basins. It is probable that during the subsequent periods of the Paleozoic, this area was generally above the sea, but was low lying and suffered little erosion.

B. Post-Paleozoic Time

At the close of the Paleozoic, all the eastern interior was raised above sea level, and there was extensive deformation in what is now the Appalachian Mountain region. Long continued erosion then followed resulting in the formation of an extensive peneplain in Cretaceous time. Evidence of this peneplain still remains in the mountain regions, but has been obliterated from the great interior areas underlain by less resistant rocks, where it was no doubt also formed. After the formation of the Cretaceous peneplain, there was an uplift which inaugurated a second great period of erosion, again resulting in the formation of a peneplain in Tertiary

*Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 687.

†Bassler: Proc. U. S. Nat. Mus., xxxix, 1911, pp. 509, 517; U. S. Nat. Mus. Bull. 92, 1915, vol. 2, pl. 3.

‡Foerste: Amer. Jour. Sci., vol. 18, 1904, pp. 321-342.

§Kindle and Barnett: Ind. Dept. Geol. Nat. Res., 33rd Ann. Rep., 1908, p. 401.

time. This peneplain which was only partial in the mountain regions, was almost completed over vast areas of the interior of the continent.* At this time the area at Cincinnati was peneplained. This Tertiary peneplain is represented by the level crests of the hills about Cincinnati. Upon this plain, stood a few low-lying monadnocks, which now show a very low swells above the flat-topped uplands. The Tertiary peneplain was uplifted, and then began the development of the present topography of the region. At the beginning of the Pleistocene period, most of the present stream valleys were formed, and the topography was similar to that of today. During the Glacial Epoch the topography was modified by changes in drainage, by the deposition of till, and by outwash deposits. Post-Pleistocene erosion has completed the development of the existing topographic features.

IV. History of the Nomenclature

Early in the nineteenth century, the "Blue Limestone" as the Cincinnatian series was then called, became well known because of its wonderfully abundant fauna. Many attempts have been made to correlate it with the formations of the eastern states, resulting in the application, at different times, of various names. At one time it was considered by James Hall to be the equivalent of the Trenton of New York (including Trenton, Hudson River, and Utica slate), and throughout Volume I of the New York Paleontology, reference is made to the Cincinnatian series as the "Trenton limestone." Nickles, in 1903, in his paper, "The Geology of Cincinnati"† gave a concise and adequate account of the history of the nomenclature up to that time. At that time, the names Utica and Lorraine were accepted terms. Later investigations have shown that the Utica of New York is represented by only the basal five feet of the formation formerly called Utica at Cincinnati. To this five feet the

*Campbell, Richmond Folio (No. 46); Fenneman, U. S. Geol. Surv., bull. 348, p. 43.

†Nickles: Jour. Cin. Soc. Nat. Hist., vol. 20, 1902, p. 52.

term Fulton has been applied* and the major part of the formation formerly called Utica is now known by Orton's term Eden.† The Fairview and McMillan formations have until recently been included under one formational name. For many years, this series of strata was considered to be the equivalent of the New York Lorraine, and was known by this name. Later, as it became evident that these strata were not the exact equivalent of the Lorraine, the name Maysville‡ was proposed. This name was used for several years, but is now being superseded by two names, Fairview and McMillan, which Bassler§ has proposed for the two divisions of the Maysville which he raises to formational rank. These two formations, together with the Eden and Utica, he included in the Covington group. Recently the Richmond has been referred to the lower Silurian.‖

The following table is intended to show the scope and equivalents of the various names which have been applied to parts of the Cincinnatian series in the vicinity of Cincinnati.

*Bassler: Proc. U. S. Nat. Mus., xxx, No. 1442, 1906, p. 9.

†Winchell and Ulrich, Geol. Nat. Hist. Surv. Minn., vol. 3, pt. 2, 1897, p. cii.

‡Foerste: Science, N. S. vol. 22, 1905, p. 150; Nickles: Ky. Geol. Surv. Bull. 5, 1905, p. 15; Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 621.

§Bassler: loc. cit. p. 10.

‖Bassler: Proc. U. S. Nat. Mus. xxxix, 1911, p. 509-517; U. S. Nat. Mus., Bull. 92, 1915, pls. 2, 3, 4.

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(*To be continued*)

VOL. XXII. No. 2.

THE JOURNAL

OF THE

Cincinnati Society of Natural History

Published November 1, 1917

CONTAINS:

SYNOPSIS OF THE COLEOPTEROUS FAMILY CISIDAE (CIOIDAE) OF AMERICA NORTH OF MEXICO .... By CHARLES DURY

THE MUSEUM SITUATION IN CINCINNATI By NEVIN M. FENNEMAN

NOTES ON RICHMOND AND RELATED FOSSILS .... By AUG. F. FOERSTE

SYNOPSIS OF THE COLEOPTEROUS FAMILY CISIDAE (CIOIDAE) of America North of Mexico

By Charles Dury

The beetles in the above area comprised in this family exclusive of the *Rhipidandrinae*, which have been removed to the *Tenebrionidae*, are of small size, subcylindrical form, mostly of black or brownish colors, though a few species of the different heretofore described genera have red or yellow elytral maculation. They live in woody fungi of the different polyporoid kinds. Males of many of the species have variously shaped horns or processes on the head or anterior margin of prothorax, and secondary sexual marks on the first ventral segment. The number of antennal joints vary from eight to eleven in the different genera. The antennae are inserted at the anterior margin of the eyes and the terminal joints are large and form a rather loose club. Tarsi 4-jointed. The Prothorax, which has a lateral margin, is more or less prolonged over the head. Mentum corneus. Labial palpi 3-jointed. Maxillary palpi short and 4-jointed. Ventral segments five in number. The first longest. Anterior and middle coxae oval, not prominent, without trocantin. Hind coxae transverse and separated. Tarsal claws simple. But few species exceed 3mm. in length. Because of their small size and dull colors they are rather unattractive, and have been much neglected by collectors. However, if they are studied with high enough power it will be seen that they are among the most interesting of Coleopterous insects. The secondary sexual characters of the males of some of the species being quite remarkable. The North American species are of but little economic importance so far as is known, though they and their larvae are voracious feeders on the substance of the inner parts of woody fungi. They are generally gregarious and sometimes occur in great numbers. From a small piece of tough, woody polyporus broken from a log, was hatched scores of adults. They continued emerging all winter. When they first hatch they are soft and pale and require several days to acquire the dark colors of the mature

insect. They vary considerably in size and in the degree of development of sexual characters. To study them to advantage they should be clean and have antennae and foretibiae drawn out and some specimens mounted ventral side up. Some of them are very tenacious of life and require strong killing substances. The literature on the family is not very accessible. Mellie's papers are in the Annals of the Entomological Society of France, vol. vi, p. 271, 1848. Casey's paper on the North American species is in the journal of the New York Entomological Society, vol. vi, No. 2, p. 76, June 1898. Dr. E. J. Kraus has a paper, with plates, on the bicolored species, in Proc. Ent. Soc., Washington, D. C., vol. x, Nos. 1 and 2, p. 74. Prof. Blatchley gives descriptions of Indiana species (three new ones described) in Beetles or Coleoptera of Indiana. Geological and Natural History Survey. Le Conte and Horn in the classification, place the *Cioidae* in both the clavicorn and serricorn series, as they exhibit affinities in both directions. Casey considers them serricorn. W. F. Kirby in his textbook (1892) places them in his section *Teredilia*. They are widely distributed in North America, occurring from the Atlantic to the Pacific and from the gulf to Canada. At Cincinnati, Ohio, I have taken sixteen species. In Maj. Casey's paper, referred to above, he gives a table of Cioinae, p. 77, which I have modified as suggested by a much larger and more complete material, and added genera and species discovered since its publication. I am indebted to the following who have kindly loaned and presented me with specimens: H. P. Loding, Mobile, Ala.; Prof. W. S. Blatchley, Indianapolis, Ind.; C. A. Frost, Framingham, Mass.; Chas. Leng and Chas. Schaeffer, of New York; W. E. Snyder, Beaver Dam, Wis.; H. W. Wenzel, Dr. Castle, and Phil. H. Laurent, Philadelphia, Pa.; Geo. F. Moznette, Corvallis, Ore.; Dr. F. E. Blaisdell, Prof. H. C. Fall, Dr. A. Fenyes, and G. R. Pilate, of California; R. T. Kellogg, of New Mexico; W. Knaus, of Kansas; Thos. L. Casey, Washington, D. C.; Miss A. F. Braun, Cincinnati, O., and others.

GENERIC TABLE OF CIOINAE

Antennae with eleven joints . . . 1
Antennae with ten joints . . . 2
Antennae with nine joints . . . 7
Antennae with 8 joints . . . 8

1—Prosternum long before coxae. Not carinate between them. Lateral thoracic margin entire to apical angles Maxillary palpi stout, last joint widely truncate . . . **Sphindocis**

2—Prosternum well developed before coxae. Lateral margin of prothorax entire. Last joint of maxillary palpi bluntly pointed . . . 3

Prosternum very short in front of coxae and transversely emarginate in front . . . 6

3—Prosternum simple or nearly so . . . 4

Prosternum tumid or carinate along the middle . . . 5

4—Body setose or pubescent; the vestiture erect and bristling. The anterior tibiae produced and dentiform externally at apex, though sometimes simple . . . **Cis**

Body elongate and glabrous. The anterior tibiae unarmed at apex. Elytral suture margined towards tip. The head rather less deflected than usual. Head and prothorax simple in both sexes. Males with a deep rounded setigerous forea at center of first ventral segment . . . **Orthocis**

5—Body glabrous or with very short, decumbent pubescence, or inclined setae . . . **Xestocis**

Body opake and setose. Last joint of maxillary palpi grooved on outer side. Prothorax strongly, obliquely strigose on sides beneath. **Strigocis**

6—Body very short and stout, wider behind; pubescence stiff and erect; prosternum deeply emarginate in front . . . **Brachysis**

7—Body stout, convex, coarsely cribrate and setose. Anterior tibiae strongly, obliquely produced and acute at apex . . . **Plesiocis**

Body oval, small, feebly shining. Anterior tibiae produced externally at apex Epistoma transversely sulcate. Vestiture of bristling setae. Secondary sexual mark of male on first ventral segment. **Sulcasis**

Body narrow, subparallel and very small. Antennae with a 2-jointed loosely articulated club. Antennal grooves before the eyes distinct. Elytra striato, punctate . . . **Dyphyllocis** Reif
Maphoca Casey

Body narrow, cylindrical, feebly sculptured and glabrous. The anterior tibiae thickened and rounded and spinulose externally at apex . . . **Ennearthron**

8—Anterior tibiae swollen, rounded and spinulose externally at apex as in ennearthron. Head and prothorax strongly modified in the male... **Ceracis**
Anterior tibiae narrowly triangular. The external edge straight throughout and minutely spinulose. Head and prothorax not modified in the male.............................. **Octotemnus**

GENUS CIS Latreille

Antennae with ten joints. The club 3-jointed. Prosternum well developed before the coxae and rather flat between them. Lateral margin of prothorax acute to apex. Anterior tibiae either finely produced and dentiform or simple at apex. Secondary sexual modifications of the head, prothorax and first ventral segments of males of many of the species. The epistoma and frontal angles being sometimes the only parts affected. The following twelve species are described as new. Following the descriptions is a table of the eighteen species, described since the publication of Col. Casey's paper before referred to. In this paper, p. 78, he gives a tabular description of twenty-two species of the genus *Cis*. Eighteen of which are there described for the first time. Of the species enumerated in the Henshaw check list, some of Mellies' are unknown to me, and it is impossible from the descriptions or figures to tell exactly what they are, and only an examination of the types can positively decide, and it is possible that some of the species described since may be synonymous with some of them. Casey's species described in the paper above referred to (the types of which I have examined) are mostly strongly characterized species. I have yet some species that I think are undescribed, but I await more specimens before describing them.

Cis arizonae, n. sp.

Form stout, elongate, cylindric. Color dark piceous, submetallic, shining pubescence, very sparse and inconspicious, arranged without order. Clypeus produced into two flat, slightly upturned processes. Front flat. Prothorax one-fourth wider than long, with base truncate. Apex in male produced into two stout, rounded processes, obtuse at tip, and the

emargination between them evenly rounded. The apex of the female prothorax being slightly emarginate. The punctuation of prothorax is closer and finer than that of elytra, which are nearly twice as long as wide and rather coarsely and deeply punctured. The first abdominal segment of male without fovea or other mark. Length 4-30 mm. This is the largest species I have seen and was collected by myself on Polyporus fungus in Madera Canon, Santa Rita Mountains, Arizona, July 23, 1915. Twelve specimens.

Cis lodingi, n. sp.

Body stout and thick; very convex, suboval in outline from above: piceous in color. Pubescence yellow, bristling, moderate in length, subdecumbent. Head sunken, flat in front, with a shallow transverse impression across base of epistoma, subfoveate at middle. Epistoma produced with margin reflexed, subangulate in front of each eye, angulate and deflexed at middle. Surface of head alutaceus and with large variolate punctures. Antennae with third joint about as long as fourth and fifth together. Tenth joint longer than wide and pointed at tip. Prothorax very high and projecting over head at apex. Strongly margined. Apex of prothorax slightly emarginate at middle. Punctures variolate, sparse and shallow. Scutellum small and transverse. Elytra slightly wider than prothorax and not twice as long as wide. Bristles not serial in arrangement. Elytral punctures rather coarse and deep. Humeri small, but prominent. Anterior tibiae flattened, carinate on its outer edge, produced at apical angle, terminating in a sharp spur. Prosternum long before coxae; wide and flat between them. Size, 2-08 x 1-01 mm. The above description was drawn from the male which has no secondary sexual mark on first ventral segment. The female does not differ much. Because of its thick body and sunken head this species resembles some *Cryptocephalus* in outline when viewed from the side. Eleven specimens from Mobile, Ala., collected by Mr. H. P. Loding, to whom it is dedicated.

Cis bicolor, n. sp.

Elongate, cylindrical. Colors dark brown and ochre yellow. Head with front margin of epistoma rounded and with the transverse suture deep and strong. Front concave. Antennae 10-jointed. Prothorax dark brown in color, finely, densely punctured. Apical margin simple. Hind angles prominent, wider at base than elytra. Elytra with a transverse dark brown basal band for one-third their length. The brown extending along elytral margin nearly to apex. The apical two-thirds of elytra ochre yellow. Each elytra with an elongate spot of brown in front of declivity. Vestiture of dense, conspicious setae, arranged without order. Elytra narrower than prothorax and fully twice as long as wide. Two males. The first ventral segment has a large flat fovea, whose surface is finely papillose. Length 2 mm. Tybee Island, Ga. H. W. Wenzel, who has one male, and my own collection, one male. The female has not been seen.

Cis julichi, n. sp.

Form elongate, rounded. Color castaneous, with legs and antennae pale testaceus. Eyes moderate and prominent. Epistoma emarginate at middle in male, with two widely separated blunt angles. The female epistoma is squarely truncate. Third joint of antennae elongate, slender, much longer than fourth. Fifth as long as wide, sixth and seventh wider than long. Punctures single. Vestiture consisting of strong bristles, arranged without order. Prothorax as wide as elytra, with apex simple in both sexes, strongly margined at sides and base. The apex of foretibia is squarely truncate and simple. The fifth ventral segment of male is very short (longer in female) and there are no sex marks on first ventral segment. Length 1.75 mm. New York City. Collected by the late Wm. Julich, to whom it is dedicated. Received from Chas. Leng, who has Cotypes. Six specimens examined.

Cis blatchleyi, n. sp.

Piceous shining. Body rather short and stout, sparsely covered with pale setae, not serially arranged. Punctures

coarse. Head flat. Epistoma reflexed and produced into two small denticles at middle, emarginate between them. Antennae 10-jointed. Eyes not prominent. Prothorax slightly produced at apex into two feeble angles, emarginate between them. Four specs. Length 1.75 mm. Dunedin, Fla. W. S. Blatchley to whom it is dedicated.

Cis cylindricus, n. sp.

Elongate, cylindrical. Black, very like *Cis hystricula* Csy., but differs as follows: Head larger, elytral punctures, very coarse and deep, setae coarse and sparse. Clypeal tubercles porrect. Male with fovea at middle of first ventral segment. I compared this species with the type of *hystricula* in Col. Casey's collection. He agreed with me that it was not the same as that species. Length 2 mm. Umatilla Co., Oregon. Abundant. G. F. Moznette.

Cis wenzeli, n. sp.

Elongate, cylindrical. Elytra piceous. Prothorax piceo castaneous. Punctures dual and all rather fine. Setae fine, subdecumbent, inconspicuous. Epistoma truncate, feebly angulate each side in front of eyes. Prothorax, with sides parallel, hind angles prominent, apex simple in both sexes. Beneath, the male has first ventral simple. Anterior tibia feebly everted externally at apex. 2 mm. Del. Co. Penn. Four specimens. H. A. Wenzel, to whom the species is dedicated. Taken in abundance in *Polyporus versicolor*.

Cis huachucae, n. sp.

Form oval; short, broad and very convex. Color pale (immature). Punctures shallow, dense. Vestiture of long, stiff, erect sharp-pointed bristles. Epistoma produced with a tooth-like angle in front of each eye and two smaller teeth at middle. Front flat. Prothorax wider than long; sides strongly rounded and convergent at basal and apical angles. Apex produced into two small, gradually formed processes, very close together. A shallow line running from base to apex at middle. Elytra as wide as prothorax and less than twice as

long as wide. A poorly defined fovea on first ventral segment Length 2.25 mm. One male specimen. Huachuca Mountains, Arizona. Miller Canon. This species comes nearest vitula Mann, but is very distinct. Type in collection of H. W. Wenzel.

Cis frosti, n. sp.

Brown; very broadly oval, convex, densely punctured, closely covered with short yellow bristles. Head flat, with shallow forea in middle, clypeus prolonged each side into two flat triangular processes, rather deeply emarginate between them. Prothorax wider than long, apex slightly emarginate at middle and prominent, projecting over the head. Front angles blunt, but very prominent. Side margins broad and strong. Base feebly margined. A shallow impressed longitudinal line at middle. Elytra very broad and ogivally rounded to apex. Length 2 mm. Width .09 mm. Orono, Maine. This is the broadest species for its length I have seen. I have but one male, presented by Mr. Chas. A. Frost, Framingham, Mass., to whom the species is dedicated.

Cis floridae, n. sp.

Form oblong oval. Vestiture fine and long. Epistoma produced into two triangular processes, deeply emarginate between them. Prothorax with sides subparallel, converging towards apex, which is produced into two porrect, flat, rather broad, gradual processes. Punctures fine and moderately dense. Elytra slightly over one and one-half times as long as wide. Punctures coarser than those of prothorax. First ventral with a round fovea on posterior half. The female has epistoma and prothorax simple and lacks the ventral fovea. Color pale castaneous. Length 2 mm. Key West, Florida. A pair only.

Cis serricollis, n. sp.

Broad, oval in form. Color dark brown. Vestiture of short bristles, conspicuous, arranged without order. Head with epistoma subtruncate in front, reflexed each side and narrowly deflexed at middle. Front flat and sparsely punctured. Pro-

thorax wider than long; sides strongly margined. The edge finely serrate, with serrations that resemble elongate beads. Punctures dense and fine. Elytra one and one-half times as long as wide, with punctures dual and dense, the larger ones shallow and shining at bottom. Beneath densely punctured, the ventral segments coarsely so. The anterior tibiae simple at apex. Males without modifications of prothorax or first ventral segment. Length 2-50 mm. Width 1 mm. Three specimens. Linn Co., Oregon. G. F. Moznette.

Cis pusillus, n. sp.

Elongate, oval. Piceo castaneous, shining. Antennae, tibiae and tarsi pale. Vestiture very minute, scant and inconspicuous. Head with epistoma emarginate at middle, with short blunt processes each side. Antennae 10-jointed. Prothorax with strong uniform punctures. Apex with slight emargination at middle. Punctures of elytra dual, the larger ones foveiform, shallow and shining, the smaller sparse scattered and bearing minute bristles. Anterior tibiae slightly everted externally at apex. Male with a fovea just posterior to middle of first ventral segment. Length 1.40 mm. Two specimens. Prof. W. S. Blatchley, Dunedin, Fla. This minute species looks very unlike a typical *Cis*, but the difference in facies is hardly of generic importance.

Cis crebberima, Mellie

The male has a fovea at middle of first ventral segment. The species is quite variable in size and degree of convexity. Otherwise the description covers the points of structure.

Cis falli, Blatchley

Prof. Blatchley has loaned me his Indiana types of this species, which seems to be abundantly distinct. In addition to the diagnostic points given in the original description (Coleoptera or beetles of Indiana, p. 898). From a fully developed male I note that the last joint of maxillary palpi is truncate at tip and somewhat securiform. The third antennal joint is

as long as the fourth and fifth together. The epistoma has two small teeth or angulations on each side of middle, with a strong emargination between them. The foretibiae are produced externally at tip into a point. The male has a sharply defined fovea on first ventral segment. Taken also at Cincinnati, Ohio and Mobile, Ala.

Cis fuscipes, Mellie

The species that is known as fuscipes in collections and was so considered by LeConte, Horn and the older coleopterists, is a stout, rounded piceous species, with pale legs and antennae. The punctures are dual and surface rugulose. The vestiture of conspicuous bristles is arranged in regular rows. The epistoma is simple but reflexed and slightly truncate or feebly rounded in front. The prothoracic apex is rounded and rather prominent in both sexes. The males have no mark on first ventral segment. In size the specimens vary from 1-08 to 3 mm. Specimens have been seen from nearly every state in the United States, even California (Alameda Co.). At Cincinnati, Ohio, it is very abundant and lives in various Polyporoid fungi. No other *Cis* is as common and widely distributed as this. A comparison with the type only will decide if this is the species described as *fuscipes* by Mellie. The form considered *chevrolati* in collections seems to be a variety of the variable *fuscipes*. The species described as *carolinae*, Casey is said to differ in having the third and fourth joints of the antennae equal in length. Specimens from Cincinnati, identified as *carolinae* by Col. Casey, have this character. but I find it a variable one. Otherwise I can see no difference between it and *fuscipes*.

Cis impressa, Casey

Journal, New York Ent. Soc., vol. vi, No. 2, p. 79. This is an abundant species in various localities in California, Oregon, Idaho, and seems to extend across the country as far as East Machias, Me. I also have specimens from Swansea, Mass. I can not see any constant specific difference between

the eastern and western forms. The proportional length of antennal joints is variable, particularly between males and females. They have, in the male, a fovea at middle of first ventral segment. In a male, from Maine, this fovea is concealed by a tuft of yellow hairs. These hairs seem to be wholly or partly removed in other specimens. The females closely resemble *Cis fuscipes.* The males are easily recognizable by the large impressed space at apex of prothorax.

TABLE OF CIS (DESCRIBED SINCE 1898)

Bicolored species, with well-defined markings on prothorax and elytra . 1
Piceous or brown-colored species (paler when immature), without well-defined markings.. 2

1—Straw yellow, maculate with piceous. Epistoma not punctured, opake. Slightly elevated and subquadrate. Elytra with black at base and transverse band at apical, third extending along suture to apex. Length 1-02 mm. Cayamas, Cuba. Florida. **superbus** Kraus

Brownish yellow, maculate with blackish. Epistoma sparsely punctured, broadly semielliptical. Elytra black at base and with two spots posterior to middle. Length 1-05 mm. Victoria, Texas. **bimaculatus** Kraus

Dark brown, maculate with yellow. Epistoma, with deep transverse groove at suture. Elytra brown at base, with apical two-thirds yellow; two elongate brown spots or clouds in front of declivity. Length 2 mm. Subopake, Tybee Island, Ga.......... **bicolor** Dury

2—Larger species 2.50 mm. or over in length. Punctures single. Vestiture not serial in arrangement.................................. 3

Medium sized species not over 2 mm. in length..................... 4

Very small species less than 1.50 mm. in length... 5

3—Very large and convex. Elytral punctures fine and dense. Male with strong secondary sexual characters on prothorax and first ventral segment. Epistoma, with two flat, sharp processes. Length 4-30 mm. Santa Rita Mountains, Ariz............. **arizonae** Dury

Smaller, very convex. Elytral punctures sparser. Male sexual characters on epistoma, which is angulate and deflexed at middle. Length 2.08 mm. Mobile, Ala...................... **lodingi** Dury

Short, broad, convex. Vestiture fine, long and conspicuous. Male sexual marks at apex of prothorax and first ventral segment. Epistoma with two large, blunt, triangular processes. Length 2.06 mm. Indiana—Ohio.................................... **cornuta** Blatch.

Shaped like **cornuta.** Vestiture coarser. Epistoma quadridentate. Length 2.25 mm. Huachuca Mountains, Ariz..... **huachucae** Dury

Elongate, convex, shining black. Vestiture scant, inconspicuous. Elytral punctures dual, strong and dense. Epistoma emarginate at middle, with a small denticle each side. Length 2.02 mm. Indiana, Ohio and Alabama........................**falli** Blatch.

Broad, oval; brown in color; punctures dual. Vestiture abundant, conspicuous. Prothoracic margin serrate. Epistoma deflexed at middle. Length 2.50 mm. Linn Co., Oregon.....**serricollis** Dury

4—Elongate; smaller and more depressed than **falli**. Piceous in color. Allied to that species. Length 2 mm. Indiana and Alabama. **confusus** Blatch.

Elongate, cylindrical, black. Elytra with coarse, deep, single punctures. Vestiture short and bristling. Epistoma of male with porrect tubercles. Near **hystricula** Csy., but differs in the larger head and coarser punctures. Length 2 mm. Umatilla Co., Oregon. **cylindricus** Dury

Elongate, cylindrical, piceous. Vestiture fine and subdecumbent. Punctures dual. Epistoma truncate, feebly angulate each side in front of eyes. Length 2 mm. Delaware Co., Penn....**wenzeli** Dury

Elongate, rounded in form. Color castaneous. Punctures single. Epistoma emarginate at middle, with widely separated blunt angles each side in the male. Squarely truncate in the female. Length 1-75 mm New York City...................**julichi** Dury

Oblong, oval. Epistoma strongly produced into triangular processes. Prothorax with subparallel sides. Length 2 mm. Key West, Fla. **floridae** Dury

Short and stout. Piceous, shining. Vestiture sparse and inconspicuous, arranged without order. Epistoma reflexed and produced into two small denticles at middle. Length 1.75 mm. Dunedin, Fla. **blatchleyi** Dury

Very broad, oval. Brown in color. Vestiture of conspicuous yellow bristles. Epistoma prolonged into flat triangular processes each side, deeply emarginate between them. Length 2 mm. Framingham, Mass...**frosti** Dury

5—Elongate, oval. Pico-castaneous, shining. Vestiture minute and sparse. Epistoma emarginate at middle, with blunt processes each side. Length 1.40 mm. Dunedin, Fla..........**pusillus** Dury

ORTHOCIS, Casey

Orthocis longula, n. sp.

Form very narrow and elongate. Shining, rufo piceous in color. Punctures coarse, legs and antennae pale. Head with the clypeal margin slightly angulate, each side in front of eye

and strongly reflexed at sides, but not so at middle. Eyes moderate in size, but very convex and prominent. Antennae with ten joints. Third joint long and slender, fourth not as long as third, also slender. Fifth and sixth short, slightly longer than wide. Seventh beadlike, not longer than wide. The three joints comprising the club as long as wide. Prothorax about as long as wide. Elytra two and one-half times as long as wide. The Prothorax is subquadrate in form and as wide at front angles, which are right angles, as at base. Sides straight. Ligula narrow and strongly concave along middle. Length 1-.06 to 2.08 mm. Five specimens. Pennsylvania and Florida. This species has the head flatter than *Orthocis punctata* Csy., but the punctuation of the two species is about the same. It varies much in size. *Orthocis punctata* Csy. also seems to vary much in size. Specimens from North Georgia being very large. 3-02 mm. in length. New Jersey specimens are 2-5 mm., while one from Michigan is but 2-02 mm. The strength of the sutural margin also varies. One from Tybee Island, Ga., has it almost obsolete. I have not taken it at Cincinnati, Ohio.

Orthocis aterrima, Csy.

I have only seen the type of this species. There were no specimens in any of the California collections examined. It is from Alameda County, California. The five species of *Orthocis*, which genus is described in Casey's paper, before referred to, p. 84, tabulate themselves as follows:

Elytra unicolorous 1

Elytra bicolored 2

1—Ligula broad and flat. Third antennal joint nearly or quite as long as the next two combined. Georgia, Michigan, New York, New Jersey and Massachusetts........................ **punctata** Mellie

Ligula narrow and strongly concave. Third antennal joint as long as the next two, nearly as long as the next three combined. Pennsylvania and Florida................................ **longula** Dury

Ligula narrow and convex. Third antennal joint distinctly shorter than the next two combined. California.............. **aterrima** Casey

2—Elytra straw yellow; maculate with black in shape of band from base to apex along suture, with cross bands to side margin, at base and middle. Third antennal joint as long as next three combined. Key West, Florida. 1-07 mm. . . . . **huesanus** Kraus

Elytra yellow, with a transverse black band at base and another at apical third. Third joint of antennae much shorter. Key West, Fla. 1-03 mm. . . . . **pulcher** Kraus

XESTOCIS, Casey

Journal of New York Entomological Society, No. 2, vol. vi, 1898, p. 85.

Xestocis singularis, n. sp.

Oblong, oval, glabrous, shining. Piceo castaneous in color. *Male*—Epistoma reflexed, angulate at sides, slightly marginate at middle. Front deeply concave, smooth. Antennae 10-jointed stout, third joint as long as fourth and fifth together, fifth, sixth and seventh very transverse. First two joints of club as long as wide, last joint longer. Eyes moderate in size, but very prominent. Prothorax as long as wide, wider than elytra, sides arcuate, hind angles rounded, strongly margined at base and sides. The front angles rather acute and extending across front as a carina into the porrect blunt horns or processes. These horns are of very singular shape, being curved upwards and outwards at tip, with a thick carina running lengthways with the horns. The upper edge of this carina being convex and highest in the middle. Between the horns, which are widely separated, is a shining subquadrate depression. At base of horns on outer side it is strongly strigose. It is also strigose at sides and across base of prothorax. Punctures rather fine and uniform. Elytra narrower than prothorax and less than twice as long, substriate. Punctures dual. Large and foveiform ones in rows, and minute ones scattered along interspaces. Beneath the prothorax is long before the coxae, which are large and prominent, with a sharp carina between them. The anterior tibiae are flattened and carinate on outer edge, with a produced apical angle, rounded and finely

denticulate. The first ventral segment has a rounded, finely punctate fovea, with a row of long yellow hairs, springing from its anterior margin and pointing backward over it. Length 2-02 to 1-08 mm. The female is smaller and lacks horns and ventral fovea and her ventral segments are pale. Eight specimens. Cincinnati, Ohio, Kentucky, Alabama and Tennessee. (Cumberland Gap). Specimens in National Museum with larvae, from District of Columbia.

Xestocis moznettei, n. sp.

Oblong oval. Thorax piceous, elytra brown, with a large reddish blotch at humeri and another near apex. Basal joints of antennae and legs paler. Punctures dual, the smaller ones bearing short, pale bristles, not serial in arrangement. Head has epistoma emarginate at middle, on each side of which the margin is reflexed into triangular processes. Front with a shallow foveate depression. Prothorax evenly and finely punctured; sides arcuately rounded and strongly margined around base. Elytra twice as long as prothorax, with the larger punctures substriate in arrangement. Beneath the prosternum is strongly tumid between coxae. Males have a rounded fovea on first ventral segment. The females lack this fovea. Average length 2 mm. Fifty specimens. Bred from Polystictus. Corvallis, Oregon, March 10, 1915. Geo. F. Moznette.

Xestocis davisi, n. sp.

Male. Broad. oval. Rather pointed before and behind. Shaped like *opalescens*. Piceo castaneous in color. Clypeus biangulate. Front concave. Prothorax wider than long, finely, closely punctate. Apex produced into a short process, emarginate at tip. Elytra one and one-half times as long as wide; finely, deeply, punctate. Conjointly pointed behind. Beneath with a fovea on first ventral segment. Length 1-50. Width 0-6 mm. Female lacks fovea and process of prothorax. Three specimens. Staten Island, N. Y. Named in honor of Wm. T. Davis, who knows more of the faunae of Staten Island than any one I know of.

Xestocis quadridentatus, n. sp.

Elongate, suboval, shining. Piceo castaneous in color, with pale legs. The male has the epistoma strongly quadridentate and reflexed; front of head concave. Maxillary palpi, with last joint large, oval and bluntly pointed. Antennae 10-jointed. Third joint slender and longer than fourth. Fourth, fifth and sixth decreasing in length and increasing in thickness. Three-jointed club loose, with the terminal joint rather pointed. Prothorax about as wide as long. Sides arcuate and margined as is base. Apex produced into two triangular flat horns. Punctures strong, deep, uniform and close set, as are those of elytra, which are as wide as prothorax and one-half longer than wide, bristling with pale pubescence, arranged without order. A small, deep fovea at middle of first ventral segment. Females are without the epistomal teeth and ventral fovea. Length 1.50 to 2 mm. Twenty-two specimens. Framingham, Mass. Mr. Chas. A. Frost.

Xestocis castlei, n. sp.

Suboval in form, rufopiceous in color. Moderately shining. Horns, head and legs pale. Vestiture composed of rather dense, short, stout, yellow bristles, not at all serial in arrangement. Male. Head broad; eyes small. Front flat, with epistoma reflexed and produced each side into two widely separated sharply pointed horns, which are curved upwards and carinate beneath from their base to apex. Antennae 10-jointed. First joint very thick, second slightly more than one-half as thick and shorter. Third, fourth, fifth, sixth and seventh gradually decreasing in length and much narrower than second. Seventh very transverse. Three-jointed club about as long as the preceding together and with the joints feebly subquadrate. Prothorax as long as wide, sides arcuate and margined to apical angles, which are not prominent. Base truncate and finely margined. Apex produced into two prominent triangular flat horns. Elytra slightly narrower at base than prothorax, with sides visibly arcuate to the ogivally rounded apex, and less than twice as long as wide. Suture very finely beaded. Punc-

tures coarser and sparser than those of prothorax. Beneath, prosternum well developed before the coxae and sharply carinate between them. Anterior tibiae slightly thickened and rounded at tip. A circular fovea at center of first ventral segment. Female lacks fovea and horns. Length 1-06 x 06 mm. Cincinnati, Ohio. One hundred specimens. Named in honor of Dr. Castle, of Philadelphia, Pa., a veteran coleopterist and lover of nature.

Xestocis levettei, Casey

Journal New York Ent. Soc., vol. vi, p. 85. I might add to the description above cited, that the punctures are dual, consisting of larger circular ones, shallow and shining at bottom, and smaller deep ones which bear minute hairs. The male has a large fovea on first ventral segment, which is fringed with long yellow hairs. The species has a very wide distribution. I have specimens from Canada to Florida, and Newfoundland and New Hampshire to Ohio and Indiana. At Cincinnati it is very abundant.

Xestocis opalescens, Casey

To description in paper above cited, page 86. I add that the side margins of prothorax are wider behind (subexplanate), and a strongly developed male has the epistoma produced into two broad processes or horns, obtuse at tip. The prothorax at apex is also produced into two broad recurved horns. At posterior middle of first ventral segment is a large round pubescent fovea, with a sharp, deep groove around it. Terminal joint of maxillary palpi thick, oval and bluntly pointed. The anterior tibiae are sharply angulate externally. I have examined the type which seems to be a less strongly developed male. The type is from Pennsylvania. It occurs also at Washington, D. C., Virginia and Cincinnati, Ohio, but does not seem to be anywhere common.

TABLE OF XESTOCIS

Body glabrous.. 1
Body clothed with short pubescence or bristles.......................... 2
1—Clypeus bidentate in male. Prothorax simple or rounded in both sexes. Eastern United States.......................... **levettei** Casey

Clypeus bidentate in male. Prothorax armed in male. Body short, broad, shaped and proportioned as in opalescens, but smaller and glabrous. Staten Island, N. Y. .... **davisi** Dury

Clypeus monocerate in males. Apex of prothorax, with two long slender porrect processes. Rhode Island to Alabama... **miles** Casey

Clypeus reflexed, angulate at sides. Prothorax, with two thick, porrect, blunt horns, which are carinate above. Ohio. **singularis** Dury

2—Vestiture very fine and inconspicuous. Side margin of prothorax very wide; subexplanate. Pennsylvania, Ohio and Virginia. **opalescens** Casey

Vestiture composed of very fine decumbent, inconspicuous pubescence. Body bicolored. Elytra substriate. Prothoracic side margin narrower. Oregon .... **moznettei** Dury

Vestiture not conspicuous. Composed of fine simple subdecumbent hairs. Prothoracic side margin narrower. Elytra not substriate. British Columbia to Oregon .... **biarmata** Mann

Vestiture composed of very conspicuous squamules. Clypeus quadridentate. Massachusetts .... **quadridentatus** Dury

Vestiture composed of coarse, stiff, suberect squamules. Epistoma in male biangulate and with apex of prothorax subangularly produced and rounded, with tip very narrowly sinuato-truncate. Pennsylvania .... **insolens** Casey

Vestiture composed of rather dense, short, stout yellow bristles. Epistoma reflexed and produced into two widely separated horns, sharply pointed. Apex of prothorax produced into two prominent triangular flat horns. Cincinnati, Ohio .... **castlei** Dury

STRIGOCIS, n. genus

Body elongate, subcylindrical. Vestiture, consisting of short, stiff inclined setae. Maxillary palpi, with the terminal joint truncate at tip. The outer edge thickened and grooved, the inner side thin and blade-like. Antennae 10-jointed. The anterior margin of epistoma produced in both sexes. Prosternum long before coxae, carinate at middle, strongly and obliquely strigose. Front tibiae flattened externally; produced and spinulose at apex. Elytral suture sharply margined. This genus is founded on a species that will not fit any so far defined, having a combination of their characters. Related to *Orthocis* in the margined elytral suture and to *Xestocis* in prosternal carination.

Strigocis opacicollis, n. sp.

Elongate, oval. Color piceous. Legs and antennae pale. Thorax opake and alutaceus, not closely, but rather strongly punctate. As wide at base as apex. Front angles prominent; sides feebly arcuate. Strongly margined at base and sides to apical angles. Elytra more shining than prothorax and nearly twice as long. Moderately and uniformly punctured, each puncture bearing a light colored bristle, arranged without order. The humeral callus very prominent, shining and resembling a rounded tubercle. Suture finely margined more strongly behind. In the male the clypeus is projected forward in a thin broad bifercate process, behind which the front is deeply excavated into a rounded depression. The apical edge of prothorax is prolonged into an abrupt laminar process, notched at middle. There is a circular fovea at middle of first ventral segment. The female lacks this and also the prothoracic process. Beneath both sexes have the oblique strigosity before described. Fully developed males are 1-8 x 07 mm. in size. Females and depauperate males are smaller. Twenty-four specimens. Cincinnati, Ohio, Mobile, Ala., and New Jersey.

SULCACIS, n. gensus

Small size bristling with erect setae. The epistoma has the margin subtruncate across its front, with a strong sulcation at its base, between the lower border of the eyes. The apical margin of prothorax is rounded and simple in both sexes. The maxillary palpi are large, elongate and bluntly pointed. The prosternum is broadly excavated in front and flat between coxae. The antennae are 9-jointed. The anterior tibiae are produced and everted at apex. The males have sexual marks on first segment. The structure of this genus recalls *Plesiocis* Csy., but the antennal club lacks the large, sensitive pores filled with white spongy pubescence. It is a rather feebly characterized genus. I have seen two species in the above genus. They are:

Sulcacis lengi, n. sp.

Oblong, oval; cylindric in form; piceous black, subopake. Bristling with pale setae, arranged without order. Head sparsely punctate; flat in front, with a well-marked sulcation across clypeus, which is slightly produced in front. Antennae 9-jointed, with a 3-jointed club. Club joints rounded, slightly transverse, with a deep fovea on each side. Third joint elongate, as long as the fourth and fifth combined. Sixth very short, much wider than long. Prothorax as long as wide. Sides rounded and margined, as is base. Apex rounded and simple in both sexes. Elytra one and one-half times as long as wide; widest behind middle and evenly rounded to apex. Beneath the prosternum is flat between coxae and strongly transversely excavated in front. The male has a round fovea on first ventral segment, with a row of bristles around it, pointing inwards. Length 1-08 mm. Vermont. From Chas. Leng. Cincinnati, Ohio, abundant. The excavated prosternum points strongly towards *Brachycis*. It also resembles *Plesiocis*, the type of which is a California species.

Sulcacis niger, n. sp.

A species allied to *lengi*. Jet black and more shining and of more cylindrical form. Punctuation and bristles coarser and sparser. The bristles white in color. Prosternum narrower between coxae. Antennal joints differently proportioned, the third joint being as long as the fourth, fifth and sixth combined. The seventh and eighth joints wider than long. The ninth joint only being circular. Length 1.05-08 mm. Three specimens. Southern Illinois. I have received from Mr. H. W. Wenzel, of Philadelphia, a species taken by him in Del. Co., Pa., that is perhaps a race of the above. It has finer punctuation and more abundant bristles, which are more yellow in color. More specimens from intermediate points may show that there is only one species.

Brachycis brevicollis, Csy.

To the original description, Journal New York Ent. Soc., p. 86, vol. vi, I add the following: The male has a large circular cicatrix like fovea, a little posterior to the middle of the first ventral segment. The original generic diagnosis says "the side margin of prothorax is obsolescent at apical angles." In seventy-five specimens examined, this margin is sharp and strongly developed around these angles. The front tibiae are produced into a spur at apex and the middle and hind tibiae are obliquely truncate and spinulose. My specimens average 1-07 x 0-8 mm. in size. North Illinois and Mobile, Ala., from which latter place I have bred them from fungus sent by Mr. Loding. They are very abundant in Alabama, but I have not yet found them at Cincinnati.

Plesiocis cribrum, Casey

The description by Casey evidently refers to the female. Some of my smaller females fit this description closely. The males have strong secondary sexual characters. The reflexed epistoma is quadridentate; the prothorax is produced at apex into two short processes, with a broad, shallow emargination between them. The first ventral segment has a sharp, small, round fovea at middle. The females range in size from less than 2 to 3.50 mm. Fourteen specimens. Truckee, Cal., also Humboldt and Sonoma Counties.

ENNEARTHRON, Mellie

Ennearthron compacta, n. sp.

Short, round, thick and compact. Color piceous black, glabrous and shining. Head with epistoma rounded and front transversely sulcate. Prothorax about as wide as long. Sides rounded and margined around front angles, which are prominent. Apex produced into a thin lamelate process, emarginate at tip. Punctures very uniform, sparse and fine. Elytra one and one-half times as long as wide, with punctures closer and

much larger than those of prothorax. Beneath the outer apical angles of anterior tibiae are rounded and spinulose. First ventral segment of male with a circular fovea on posterior half. Length 2 mm. Width 1 mm. Key West, Fla. Bred from *Fomes marmoratus*, Berk., C. G. Lloyd, And three specimens from Round Mountain, Texas, which do not differ from the Florida specimens, received from H. W. Wenzel. This species is the broadest for its length of any I have seen. It deviates somewhat in generic characters, but they are hardly sufficient for another genus.

Ennearthron oregonus, n. sp.

Elongate, cylindrical, slender in form, shining. Head and prothorax red; elytra piceo castaneous in color. Male—Head with epistoma reflexed and produced into a rather long, broad, lamellar process, slightly emarginate at tip. Front with a strong transverse shining concavity. Prothorax about as long as wide. Alutaceous finely and sparsely punctate. Apex produced into a very thin, upturned, gradually formed process, strongly emarginate at tip. Elytra about two and one-half times as long as wide and of same width as thorax. Punctuation slightly rugose and coarser and more dense than that of prothorax. Beneath the apex of front tibiae are rounded and spinulose at apex externally. The first ventral has a small, round fovea on posterior half at middle. Length 1-50 mm. Corvallis, Oregon. Mr. Moznette. Allied to *Convergens* Csy. a large series may show the two to be identical. Two males.

Ennearthron coloradense, n. sp.

Elongate, dark piceous, shining. Head, legs and antennae pale, and the latter very elongate and 9-jointed. The third joint as long as the fourth, fifth and sixth together. Allied to *thoracicorne*, which has the third antennal joint only equal to the next two. Elytra twice as long as prothorax and slightly wider; closely and finely punctate. Prothorax alutaceus, deeply and evenly punctured, the punctures being smaller than those of elytra. Only males were seen. The epistoma

being strongly reflexed in trapizoidal process, which is emarginate above. Prothoracic process abrupt and deeply emarginate at middle. A circular fovea at posterior border of first ventral segment. The other segments transversely strigose. Length 2-04 mm. I took this species at Grand Lake, Middle Park, Colo. Only males were seen.

A subspecies of the above was taken in Grant Co., New Mexico. It is about the same size and proportions, but differs in having an impressed space behind the prothoracic process, and having this process more gradually formed. The prothorax is always red and the posterior part of elytra is always with traces of this red color. Ten specimens. Both sexes.

Ennearthron thoracicorne, Ziegl

An examination with high power shows that each joint of the antennal club has a large fovea and a small denticle on the outside of joint. The third joint is as long as the first and second.

TABLE OF ENNEARTHRON

Species with elytral maculation. bicolored... 1
Species with elytra unicolored.................................. 2

1—Prothorax mostly dark. Elytra with an irregular narrow transverse pale band at middle. Florida, Georgia, Texas and Virginia. **transversatum**

Prothorax dark medially, elytra with a broad, transverse, dusky band at base and two indistinct dusky spots at apex. Florida. **pallidum**

Prothorax with anterior half brownish. Elytra with transverse piceous band that narrows towards scutellum. Apex of elytra dusky for about one-third their length. Cuba..... **annulatum**

2—Male with a long, single, slender, erect clypeal process. Size very small...10

Males with the clypeal margin reflexed. Thoracic process bidentate.. 3

3—Males with the thoracic process longer, narrower and more approximate. Punctuation very fine, that of elytra confused in arrangement...4

Males with the thoracic process shorter, more widely separated and more lamellarly triangular; punctuation stronger............. 6

4—Apex of prothorax rather feebly impressed behind the processes. Form slender; cylindric 5

Apex of prothorax strongly impressed behind processes. Punctures of elytra finer than those of prothorax. Elytra less than one-half longer than wide. Texas and Louisiana . . . . **piceum**

5—Elytra fully one-half longer than the prothorax; slender. Punctures very fine, elytra slightly rugose. Canada to Florida. . **thoracicorne**

More slender than *thoracicorne.* Processes of thorax longer and less divergent. Thorax of female more strongly extended over head. Disk of thorax alutaceus and more evenly and coarsely punctured than *thoracicorne.* Indiana . . . . **oblongus**

Elytra very short and strongly cuneiform; very much less than one-half longer than the prothorax, which is not quite as long as wide. Elytral punctures sparse and very minute. Morgan City, La . . . . **laminifrons**

6—Thoracic process of male very abruptly formed 7

Thoracic process of male not abruptly formed, its sides merging gradually and obliquely into the sides of prothorax 8

7—Elytral punctures rather coarse. Thoracic process one-half as wide as elytra. Clypeal process very broad. California (Southern). **grossulum**

Elytral punctures close set. Angles of clypeal process scarcely rounded. Punctures generally very feebly subserial in arrangement. Color blackish. California (especially northern coast regions) . . . . **californicum**

Elytra with feebly impressed lines. Punctures feebly subserial in arrangement. Piceous. Elytra paler. Prothoracic process rather short. Lamelliform 9

8—Prothoracic punctures sparse; angles of clypeal process rounded. Color more or less rufotestaceus, the elytra sometimes blackish towards base. California . . . . **discolor**

Prothoracic punctures fine, dense. Form short, broad and compact. Epistoma rounded in front. Length 2 mm. Width 1 mm. Key West, Fla., Round Mountains, Tex . . . . **compacta**

Narrowly cylindric, blackish, elytra rufescent at tip. Clypeus with the sides strongly convergent, the apex broadly sinuato-truncate, with angles blunt. California . . . . **convergens**

Elongate, cylindric. Head and prothorax red. Elytra blackish. Head with the front strongly concave. Angles of processes sharp. Corvallis, Ore . . . . **oregonus**

Larger, elongate, cylindric, black, very shining. Reflexed process of epistoma very prominent; deeply sinuate; angles sharp. Process of prothorax long and deeply emarginate at tip. Color either piceous or with elytra piceous and prothorax red. Middle Park, Colo., Grant Co., New Mexico . . . . **coloradense**

9—Clypeus only moderately reflexed; its apex broadly truncate. Prothoracic process abruptly formed, rather short, lamelliform, with a triangular incisure at middle. Elytra substriate. Florida and Alabama. . . . . **pullulum**

10—Very small. Punctures excessively minute. Male, with clypeal process very long and narrow, with its apex rounded. Key West, Fla. . . . . **unicorne**

thoracicorne, *piceum* and *oblongus* are very close, and perhaps but one species, as the characters given to separate them vary. I include the Cuban *annulatum* as it will perhaps be found in Florida. Several of the California species are very close to each other and may prove to be the same. Tables founded on male secondary sexual characters are bad, but with so many closely allied species where characters are so feeble, it seems impossible to do otherwise.

CERACIS Mellie

Ceracis schaefferi, n. sp.

Piceo castaneous in color. Allied to *sallei*, but is smaller and does not have the elytra pale and blackish towards base. Prothoracic punctures sparser than in *sallei*. Elytral punctures dual and much coarser and deeper than in that species. Length 1.50 mm. Brownsville, Texas. Four specimens. Two males and two females received from Charles Schaeffer, Brooklyn, N. Y. The color of *sallei* when mature is characteristic in the male, and most females also have the apical half of elytra pale, which is not the case in any of the specimens of *schaefferi* I have seen.

Ceracis minuta, n. sp.

Very shining, black, with legs and antennae paler. Prothorax wider than elytra, with punctures sparse and finer than those of elytra. Processes of apex strongly developed. Elytral punctures closer and larger than those of prothorax, otherwise the species is like *Ceracis punctulata* Csy., but it is much smaller. 1-01 mm. in length. I took fifteen specimens of this minute species at Palm Beach, Florida, June, 1913. The first ventral segment has a round fovea at middle. This is the smallest *Ciside* I have seen, except the Florida *unicorne* Casey.

Ceracis bifoveatus, n. sp.

A rather slender species, somewhat like punctulata above, in shape, color and size. The elytral punctures being coarser and more dense than those of prothorax, which is squarely truncate at base, alutaceous and at posterior angles strigose. The outer tip of anterior tibiae are rounded and spinulose. The male secondary sexual characters are very peculiar. The epistoma is reflexed and emarginate, and the apex of prothorax is produced into an abrupt process which is deeply notched at tip. The first ventral segment has a large circular fovea, surrounded by a deep groove and is convex in the middle with raised papilliae. Posterior to this and joining it is another fovea, around the posterior half of which is a row of outward radiating yellow bristles. The females lack process and ventral fovea, but are unique in having a deep fovea at middle of front. Length 1-04 mm. Five specimens. Three males and two females. Cincinnati, Ohio.

Ceracis, Mellie

Antennae 8-jointed. Male characters affecting epistoma, prothoracic apex and first ventral segment. In facies they resemble *Ennearthron*. The species may be tabulated as follows:

Rufotestaceous. Elytra blackish towards base. Eastern United States, from Canada to Texas. The most abundant species in Ohio. **sallei** Mellie

Piceo castaneous. Elytra not blackish towards base. Elytral punctuation dual and coarser. Allied to **sallei** Mellie. Brownsville, Tex. **schaefferi** Dury

Castaneous. Prothorax with a smooth, median line posteriorly. Elytra distinctly punctate. Lower California................**similis** Horn

Piceo-castaneous. Elytra strongly rugosely punctate. Secondary sexual marks on both sexes. Cincinnati, Ohio..........**bifoveatus** Dury

Black. Elytra nearly smooth; more finely punctured than prothorax. Florida and Alabama................................**punctulata** Csy.

Black. Much smaller. Elytra strongly and densely punctured. Punctures of prothorax finer than those of elytra. Palm Beach, Fla. **minuta** Dury

Octotemnus, Mellie

Casey gives a good generic diagnosis in Journal New York Ent. Soc., vol. vi, No. 2, p. 91, and describes two species, *Octotemnus denudatus* and *O. laevis*. The former from the west coast and the latter from the Eastern United States. I have seen the types. In a large series of specimens from many localities the characters given to separate them seem to run together so that I can not find any of specific value to distinguish the two. In both forms the prothorax is alutaceous, with punctures about the same. Some specimens of both are more elongate and less oval. The size averages the same. The darker ones are the more mature ones. The species is a glabrous insect, finely punctured, averaging about 1.75 mm. in length. The males are without sexual marks on either epistoma or prothoracic apex. Color from pale to dark. I have seen specimens from Pennsylvania, Ohio, Alabama, Iowa, Kansas, Oregon, Washington and California. At Cincinnati, Ohio, they live in various species of fungi and are very abundant. Those from Oregon were bred from *Coriolus versicolor* and *Polystictus*.

THE MUSEUM SITUATION IN CINCINNATI*

NEVIN M. FENNEMAN

In many civilized countries of today (and in all civilized countries of tomorrow) the public museum is an essential element. It takes its place with the public library, the stage and the public park. These four are the chief resources of organized entertainment and recreation.

The modern museum is little older than the nineteenth century and there has been more growth in the last fifty years than in all preceding history. The collection of natural objects and curios is as old as civilization, but until recent times such collections ministered to superstition rather than to knowledge. For centuries the bones of extinct animals (mastodon, etc.) were hung on the walls of churches as "giants' bones." This is still the case in certain parts of Europe. Stone axes were similarly exhibited as "thunderbolts" and arrowheads as "serpents' tongues."

One of the oldest natural history museums is the Ashmolean of Oxford. In the first half of the seventeenth century, John Tradescant, Kentish gentleman, traveler and botanist, gardener to Charles I, united with great learning a prodigious greed for collecting. His collections were assembled from the ends of the earth and covered the range of museum classification. His son, John Tradescant, after doubling his father's collections, gave them in 1659 to the famous antiquary, Elias Ashmole. By him they were given in 1682 to Oxford University and became the nucleus of the Ashmolean Museum, well known to scholars and to all who visit Oxford.

The British Museum may be said to have started seventy-one years later (1753) when Parliament purchased the large

*In writing this paper free use has been made of the proceedings of the American Association of Museums, particularly of articles by E. K. Putnam (Brief Survey of American City Museums, vol. viii), O. C. Farrington (The Rise of Natural History Museums, vol. ix), and Paul M. Rea (various historical and statistical articles).

and varied collections of Hans Sloane, to which others were soon added. The leading place which England has from the first occupied in the matter of public museums is probably due partly to her leadership in exploration, travel and trade. It is certain at least that the first great public collections drew largely upon the New World. It is not strange therefore that the same Englishmen living in that New World should act in the same manner. So the British Museum was only fourteen years old when the Charleston Library Society undertook for the province of South Carolina, the task which the British Museum had assumed for the world. The Charleston Museum was founded three years before the Declaration of Independence, and after a continuous career of one hundred and forty-four years is a model of what may be called the *sectional* museum as opposed to the cosmopolitan museum which represents the world.

The next oldest museum in America is probably the Peabody Museum in Salem, Massachusetts. It was started in 1799 by the Salem East India Marine Society, an organization composed wholly of the masters and supercargoes of Salem vessels navigating the southern seas in the vicinity of Cape Horn or the Cape of Good Hope. Up to 1909, four hundred and six members had passed this test. The collections of this social, charitable and semiscientific or technical society were to consist of "natural and artificial curiosities" brought home from long voyages. Union with other societies of more local interest has made of this museum another good type of the sectional museum. (Robinson, John—Proc. Amer. Assoc. of Mus., vol. v, p. 75.) It is now a part of the well endowed Peabody Institute.

The nineteenth century was so fruitful of museums that only the broad outlines of the movement can be noted. It will be observed that the first museums were founded by societies. Of the six hundred museums and galleries in the United States, more than one-third were thus founded and are now so supported. A slightly larger number are connected with schools or colleges. One-fifth of all are supported by

city, state or national government. The remaining seven percent are in private hands or supported by endowment.

The century following 1773 was preeminently the epoch of the *Natural History Society*. It may be said to have opened with the founding of the Charleston Museum in 1773 and closed with the founding of the Cincinnati Society of Natural History in 1870. It should, however, be remembered that this society had an earlier career under the name of the "Western Academy of Sciences." Many of these societies are in a dying condition. Their rise and decadence contains an element of pathos. Briefly stated, the several sciences, having passed the stage of superstition, had entered the *Natural History stage* and had not yet reached the *laboratory stage*. Zoology and Botany were busy describing and classifying animals and plants and learning their habits. Paleontology was doing similar work with fossils. Every local field was virgin soil and the amateur hunter rendered important service. Most significant of all, the researches of local professors and other scientific men lay along the same lines which enchanted the amateur. Leadership was thus afforded and mutual interest prevailed. There was a democracy in the pursuit of science which passed away when the work of hunting, describing and classifying had been in large measure accomplished and scientific men took up the microscope and the scalpel and gave their thoughts to problems which in their very nature do not lend themselves to popular interest. This may be called the laboratory stage of science. It begets intense specialization and much of it involves quantitative work. The interests of Biology superseded those of Botany and Zoology. Few biologists are now interested in a whole bird, or at least not in the outside of a whole bird.

Inevitable as it is, it would be folly to close one's eyes to the loss which this change involves, or to endure that loss complacently without at least an effort to keep up the ennobling influence of Natural History. Still, the truth must be told, that when the present-day scientific man participates in his local Natural History Society, it is because of a missionary interest and not because of that "enlightened selfishness" which is the

surest guarantee of the life of an organization. Public museums have grown prodigiously since Natural History societies ceased to be founded, but they have not grown for the pleasure of those who finance and manage them, but for the education, entertainment and refinement of the community. They are now benevolent or philanthropic rather than democratic in the old sense. In the old society all were, at least in theory, both givers and receivers of information. Now the distinction between givers and receivers is generally marked.

Such of the old time societies as have survived have either been privately endowed or have been subsidized, generally by their own cities. Of the two already mentioned, the Charleston Museum, beside receiving from the city a $40,000 building, receives $4,000 a year for curatorship and management. The Salem Museum is well endowed. The Philadelphia Academy of Sciences has large collections and ample resources and the Boston Society of Natural History receives nearly $14,000 a year from its endowment. The Davenport (Iowa) Academy of Sciences, founded but three years before the Cincinnati Society and having approximately the same means of support, is one of the very few which has preserved its vigor, but it has done this by entering actively into the educational field. It was one of the first to effect definite cooperation with the public schools.

As already stated, nearly two-fifths of all the museums and galleries listed in the United States belong to educational institutions. For the most part these are "poorly supported, badly cared for and not much seen." In 1909 only five colleges (or universities) and five independent societies appropriated more than $1,000 each to museums. Most colleges depend for curatorship on the voluntary services of science instructors, whose advancement in the world depends on research and not on philanthropic work for the community. Time for museum work must be subtracted from the small time allowed for research and writing. Most college museums are decadent for the same cause which affects Natural History societies. So long as the teaching of science was in the Natural History stage there was great interest in multifarious forms, but this

interest has largely been sacrificed to the intensive work of the laboratory. That the broad Natural History interest has dropped out, even in high schools, is of course an educational crime, but our concern here is with the fact, not with its justification. That such an interest *should* exist and be fostered somewhere, at some age, in some grade of school, or in some kind of an institution, is a proposition too elementary to argue. It need only be said that the Natural History interest where it exists at all, is generally centered, not in the college or university, nor even in the high school, but in the public museum.

But not all university museums are stagnant or decadent. There is, of course, no reason why a successful museum should not be run by a college. The problem is the same as that of the old time Natural History Society. Museums take time and time costs money. An instructor who gets no calls, gets slow promotion, and calls come to the man who investigates and publishes; not to the man who sacrifices his time to his community. Some of the larger universities and colleges, and likewise a few of the smaller ones have successful museums. Some of these have independent endowment. Harvard has the Agassiz Museum (Natural History) with its $600,000 endowment and other sources of income; the Fogg Art Museum similarly supported, the Peabody Museum of Archeology and a number of historical or cultural museums, German, Semitic, etc. Yale also has (among others) its endowed Peabody Museum. Beloit, Bowdoin and Smith have endowed art museums which are much used. Wellesley supports the Farnsworth Art Museum from the funds of the College. The University of Michigan appropriates annually about $7,000, most of it for salaries. The University of Colorado supports a very active museum at about $3,000 a year. Beloit also has its Logan Museum of Archeology. The University of Iowa has just erected a museum building costing (with cases) $450,000, and the University of Indiana has done almost the same. But none of these successful college museums are looked upon as departmental apparatus. None depend for curatorship on voluntary effort and spare time.

The aims of a university museum are two, research and close touch with the public. Elementary teaching does not now demand large collections; but some lines of advanced study are not otherwise possible. State institutions generally find that museums yield large dividends in the form of public interest and presumably therefore in moral and financial support.

We come now to the endowed museum. This is a late nineteenth century development, but the proportions already reached are startling. Twenty-four of our larger museums average well above a million dollars each in endowment alone. The same institutions hold $50,000,000 worth of property, beside their collections which no man can value. Aside from all administrative expenses these museums paid out in 1910 $172,000 for research alone, not counting expeditions, explorations and purchase of collections. A vast educational and scientific machine this is, built up almost wholly within twenty-five years.

The class of endowed museums is not very distinct. Some of them, like those of Harvard, receive additional support from educational institutions; others are supported in part by societies or from municipal funds. The Boston Museum of Fine Arts costs more than $80,000 a year, three-fifths of it yielded by endowment. The Field Museum, with more than five million of endowment, is also the beneficiary of the city of Chicago. Carnegie gave a six million dollar building to the Carnegie Institute of Pittsburg for Natural History, Art, Library and Music Hall. The Natural History Museum has an annual income of $85,000 and the Art Museum of $60,000 from endowment. Stephen Salisbury's endowment yields to the Art Museum of Worcester, Massachusetts, an annual income of $143,000. The Layton Art Gallery of Milwaukee, the Valentine Museum of Richmond, and the Wadsworth Atheneum of Hartford are others of this class.

Overlapping all other methods of support, is the state or municipal subsidy, generally the latter. In state museums, New York no doubt leads, but not many states are in advance

of Ohio. City support comes mainly through two channels, the Park Commission and the public schools, though the public library is in some cases the intermediary. The commonest form of aid is the giving of a site, generally in a public park. Cincinnati did this for her Art Museum. A score of large cities have done the same, but practically all of them, unless it be San Francisco, have contributed also to building or support, or both. New York, besides the millions paid for real estate, spends more than $700,000 a year on the upkeep of her Art and Natural History Museums and zoological and botanical gardens. New York has a well defined policy of paying only for real estate and upkeep. This includes all salaries, but adds nothing to the exhibits. That must be done by patrons of art and science. Her experience is that gifts and money flow in freely when it is known that they go directly into collections. Speaking at the American Museum of Natural History, Joseph A. Choate said: "The money spent by the city of New York in the development of this museum and the Museum of Art is the best investment of public moneys ever made by it, whether we consider the direct benefit to the people, or the prestige and character attained by the city as the great metropolitan center of knowledge and culture." Milwaukee spent one million dollars for a building (museum and library) and gives more than $80,000 a year to museum support. The St. Louis Art Museum, housed in a million dollar exposition building, is authorized by law to receive a mill rate which would yield $120,000 annually, but it is not yet spending more than two-thirds of that amount. The St. Louis School Board also operates an educational museum, costing about $8,000 per year. Among the various museums partially supported by Philadelphia, the one called the Philadelphia Museums receives from the city from $40,000 to $60,000 per year, beside $25,000 from the state for educational work and substantial allotments for new collections. The John Herron Art Institute of Indianapolis, beside receiving $5,000 a year from membership, receives $9,000 from the School Board. Beside St. Louis and Milwaukee already named, Providence,

Oakland, Grand Rapids, Los Angeles and some others have strictly municipal museums. The list of those receiving city aid would be wearisome. Even Chicago gives $65,000 a year to her Art Institute and has provided for giving $100,000 a year to the richly endowed Field Museum when its new building on the lake front is completed.

Before taking a brief outlook over the field in Cincinnati, a distinction should be made among museums with respect to their geographic scope. The great museums of London, New York, Chicago, etc., take the world for their field and disregard no line of interest. These may be called cosmopolitan. At the other extreme are strictly local museums which undertake to represent their own localities adequately. A large gallery of sculpture in Copenhagen contains, beside the tomb of the artist, nothing but the models and casts by Thorwaldsen. Intermediate between these types is the museum which represents a limited region; it may be a political division or a vaguely defined section. This may be called the sectional museum. An example of rigid restriction is the Ohio State Museum at Columbus, which restricts itself to Ohio and aims to approach completeness as rapidly as possible. The Germanic National Museum at Nuremberg represents only Germany. The "Nordiska Museet" at Stockholm is perhaps the most perfect example. It limits itself to Sweden and includes art, history, and botanical and zoological gardens. In Skansen Park it has perhaps the most famous outdoor museum of the world; whole houses and households with their occupants, occupations and amusements from all parts of Sweden and, so far as possible, from all stages of her history. The Deseret Museum of Salt Lake, supported by the Mormon Church, the Southwest Museum of Los Angeles and the Museum of the American Institute of Archeology at Santa Fe are excellent examples of the sectional museum.

For evident reasons art museums are rarely thus restricted. Natural History Museums frequently are; Historical Museums oftener still. Cincinnati could not wisely undertake a cosmopolitan museum. Her appropriate field is the Ohio Valley.

She ought not to be satisfied to see any other city becoming the representative metropolis of this section.

The field of the museum is fourfold—Art, History, Science and Industry. Not many American cities are ahead of Cincinnati in Art, but a few are a long way ahead and some others are gaining faster. In 1912 our Art Museum had an income of $34,000 exclusive of the Academy, whose receipts were nearly $24,000. Beside Painting and Sculpture, this museum represents Indian Archeology, though it is not in position to push this line aggressively. With this line and its armour and musical instruments, this museum occupies a part of the Historical field.

Cincinnati's traditions and tastes in Art and Music are priceless, but unsleeping vigilance is the price of their continuance. Cultured people die and children are not born with tastes for the Fine Arts. If Cincinnati aims to beat her rivals she can do it better in the game of Music and Art than in the population game. But as a man is generally vain with respect to his weakest point, so a city seems sometimes possessed to wage war where its own lines are weakest and the enemy is strongest. The thing for the Cincinnati traveling man to do is to post up on Music and Art and then tell the other fellow when he has talked enough about the census.

In most American historical museums the most important thing is Indian Archeology. Our collections in this line, while valuable, do not even approximately represent the knowledge gained from even our own immediate locality. It would not have been extravagant to hope that Cincinnati might in this respect have represented the Ohio Valley. Living as we do at a kind of focus of prehistoric civilization which left abundant remains, it is not creditable to this community that the student of Ohio Valley Archeology must go to Columbus to make a fair beginning, and then to Washington, Boston, and perhaps to England to examine the data of his science. For seventy-five years Ohio has been a hunting ground for relics of the stone age. About 1846 Squier and Davis made one of the largest of such collections. It was stored for some time in the

State House at Columbus, then at the Smithsonian, and then sold to a gentleman in England where we must now go to complete our studies of Ohio Archeology. After much of the material had been removed, Ohio started its state museum to which it now gives $7,000 a year and an excellent building for the purpose of assembling Ohio material only. As for material remaining in Cincinnati, the best known collection is now in our Art Museum. Smaller collections are found at the Natural History Society and at the University, and there is an unknown amount of good material in private hands. Its value can not be known until it is studied, but the amount still available would do something worth while toward retrieving our loss.

Aside from what is contained in the Art Museum, Cincinnati can scarcely be said to have an historical museum. There is room here for a prosperous society and an interesting museum. What advantage over Cincinnati has St. Louis, which enabled it to assemble one of the richest historical collections in the United States? If one were asked to guess at what point west of the original thirteen states such a museum should be found, he would look to a locality which had been of critical importance in aboriginal culture, settled early by the white man, the center of a large population and a point intimately associated with the great movements of war and peace. Such a place is Cincinnati, but the objects which illustrate or symbolize the great events or daily life of former times are not conserved for instruction and inspiration.

A coin collection which any museum in the world might covet was made in Cincinnati by the late Thomas Cleneay. On his death it left the city to be sold at auction in Philadelphia. Even in this manner the collection brought nearly $20,000, partly from the United States Government.

Coming to the realm of Natural History, Cincinnati appears in her best light and her worst. In the content of her Zoological Garden she is definitely outranked by New York alone, being roughly coordinate with Philadelphia and Washington, though the race with Washington is hopeless. Chicago

is beginning to crowd us. All these are subsidized by their respective cities, except our own. Even the one at Philadelphia receives municipal support of $25,000 a year. There are fifty-four zoos in the United States, that is, about one-half the cities of over 40,000 are supplied. Most of them are under the auspices of Park Commissions. New York and Detroit have extensive aquariums similarly supported.

The Botanic Garden is similar to the zoo in its social function. In all parks, of course, shrubs and trees are planted, and greenhouses are common, but a botanic garden to be worthy of the name ought to be comparable to a zoological garden in its harboring of exotic species. The richly endowed Shaw Gardens at St. Louis are perhaps the most important west of New York. The great advantages of Cincinnati in this respect are similar to those of St. Louis. It lies in the critical latitude where northern and southern species meet and acclimatization is correspondingly favored. Its topography offers a wide range of conditions, and above all, its people love flowers. A private garden planted and lovingly cared for by Mr. Tuchfarber, of Westwood, is now the property of Mrs. Mary Emery and kept for the public good. This may be the germ of something greater, but if Cincinnati is ever to have a really great botanic garden, it is more likely to develop in the Mt. Airy Forest, now city park property. The topography there is highly varied. On account of its location with respect to our prevailing winds, it is freer from smoke than any other part of the city (a very important matter in a botanic garden).

The Professor of Botany at the University once had a very modest plan of assembling in one spot, duly provided with greenhouses, all the shrubs and flowers which might be desirable for landscape gardening, public or private, in the city; such a collection to constitute a kind of reference library or showcase which anyone might consult for the purpose of choosing shrubs, flowers, and to some extent even trees to beautify his home or street, or to be of similar service to park managers. It would seem that such a project would lie well within the province of the Park Commission.

Natural History Museums owe most of their materials to two sciences: Zoology and Geology. In resources of these classes, no city in the United States is so favored as Cincinnati. Those which approach it in geologic interest do not have the zoos to supply skins and skeletons; and those which have the zoos do not have the fossils. Our zoo contained in 1909, five hundred and twenty mammals, twelve hundred birds and one hundred and twenty-five reptiles. There die each year, say, forty-five to fifty mammals, one hundred to one hundred and twenty-five birds and twenty-five to thirty reptiles. (Letter from Sol. A. Stephan, Manager.) The skins of these should be preserved. Many of them are valuable. Not all should be mounted. Many should be used as exchanges. In this way a valuable collection of skins and mounted specimens should accumulate. In scientific research these are used at least as much as the live animals. It is folly to think that they do not attract the people. This has not been New York's experience.

Fossils are, of course, our chief stock in trade. For fossils in the hills we lead all American cities; but when the ground has been patiently searched and the specimens lovingly cared for, the valuable collections have with few exceptions been drawn away to other cities. Harvard, Washington and Chicago, at least, have better collections than remain with us. Eminent research students generally visit those cities instead of Cincinnati in order to study our Paleontology. Still, a large amount of material remains. Its value is hard to state, for it can not now be duplicated. From rock long exposed, fossils are easily separated if not actually found loose. Such exposures have been in large part picked over. The new exposures constantly being made, yield their treasures with difficulty. The collections at the Natural History Society, of which fossils constitute perhaps one-half, have been valued at about $50,000, but at dealers' prices the value would be considerably greater. The collections of fossils alone owned or held by the University could certainly not be bought from dealers at less than $20,000. This would be greatly increased by shells and minerals. Several valuable collections still remain

in private hands. If all duplicates in excess of six for any one species could be exchanged for material of other localities, the value would again be greatly increased. Thus a fair chance still remains for Cincinnati to piece together a representative collection of what her own rocks yield. How long this chance will last is uncertain, for the largest single collection is in the market. The collection here referred to is that of the late Samuel A. Miller, temporarily loaned to the University. To let this slip would be to dishonor the names of the distinguished geologists who were born here or spent their lives in Cincinnati.

But the question of museums should not be thought of in terms of any one science, or any one generation, or any one city. The preservation of records is a mark and measure of civilization whether the records be in language or in concrete objects. The widespread awakening of the last twenty-five years is not so much a sudden burst of civilization as a symbol and phase of conservation and a method of education. Park Commissions and School Boards seem to share about equally the responsibility for this intellectual entertainment of the people. In favored cities private munificence has done more than either, but its work has been more localized. Undeniably, the work has entered a new and more vigorous phase, since it has ceased to be the semisocial entertainment of the few and has taken its place in community education.

The late William Hubbel Fisher, who was President of our Natural History Society at the time of his death, was one of those who saw clearly the changed conditions and the new opportunities. Under his guidance the Society prepared cases of specimens (birds, minerals and insects) to be circulated among the schools. With no improvement since they were first made, and no increase in number (seven sets of three cases each), these continued to circulate up to the year 1916. The greedy demand for these poor makeshifts is pathetic. When they had been circulating five years, Mr. Norman W. Harris, a Chicago banker, visited Cincinnati (among other places) to ascertain the workings of the plan. Several months later he announced a gift of $250,000 to the Field Museum, to endow a

system of museum extension for the public schools of Chicago. Not only were traveling collections provided, but the necessary auto truck service to keep them in circulation.

The large sums of money spent for museums in some of our cities may be discouraging. It should be remembered that these are for cosmopolitan institutions. In such institutions exploration and research are important and expensive. In the local or sectional museum a few thousand dollars goes a long way. Aside from the upkeep of a suitable building and the cost of cases, the salary of a single taxidermist would give Cincinnati a renowned collection of birds and animals in twenty-five years. Almost the same is true of fossils, if the beginning were made before any more breaks occur. Archeology would make a good showing on the same terms. Some lines would depend on purchase, but in the course of twenty-five years, the really valuable donations from a half million people would be very large.

NOTES ON RICHMOND AND RELATED FOSSILS

Aug. F. Foerste

The following notes are based upon a number of specimens collected by John Misener from the upper half of the Richmond group, at Richmond, Indiana. To this is added a discussion of *Dinorthis retrorsa*, Salter, a very rare species from the Bala group of Wales, with which it is customary to identify *Dinorthis carleyi*, Hall, from the Richmond of Ohio, Indiana, Kentucky and Tennessee. Figures are presented also of the type of *Zitteloceras hallianum*, D'Orbigny, from the Trenton of New York, with which *Cyrtoceras hitzi*, Foerste, from the Hitz layer, at the top of the Richmond group at Madison, Indiana, evidently is congeneric.

Conularia miseneri, sp. nov.

Plate I, Figs. 1 A, B, C

Shell elongate-conical, rhomboidal in cross section, rarely exceeding 40 millimeters in length. Apical angle from 15 to 18 degrees. Lateral angles strongly rounded. Lateral faces gently concave along the median line. Transversely and longitudinally striated. The transverse striations always are well defined; from 22 to 25 in a length of 5 millimeters; curvature gently convex across the median parts of the lateral faces, curving gently downward (toward the apical end) at the lateral angles. This downward curvature is greater toward those angles which are at the extremities of the longer transverse diameter, and the maximum convex curvature of these transverse striae lies nearer those angles which are at the extremities of the shorter transverse diameter of the shell. The longitudinal striae frequently are indistinctly defined along certain parts of the shell, especially near the upper end where the transverse striae often are much closer, suggesting gerontic conditions. In most specimens, however, parts of the shell show the longitudinal striae, but much less distinctly than the transverse ones. The number of longitudinal striae

in a given width varies greatly, from moderately fewer than the transverse striae in the same length to considerably more numerous.

Whitewater member of the Richmond group, at Richmond, Indiana; found by John Misener. Occurring also at the same horizon at the eastern edge of Dayton, Ohio, at the northern end of Huffman hill, where the Springfield traction line crosses over the railroad to Wellston.

Amphilichas sp.

Plate I, Fig. 2

Specimen exposing the lower side of a pygidium and of several of the posterior segments of the thorax. Margin of pygidium with three pairs of lobes. The terminations of the posterior pair are more or less rounded, and are separated by a short narrow notch. The lateral pair of lobes is more angular, and is separated from the posterior pair by a slightly deeper and wider notch. The anterior pair is not preserved in the specimen at hand, but probably resembled the middle pair. A sharply defined rib extends, on the lower side of the pygidium, from the lateral margin of the axial lobe of the pygidium approximately along the line separating the posterior and middle pairs of lobes, and another extends between the middle and anterior pairs. Beginning nearer the posterior margin of the axial terminations of these lobes, an additional rib extends diagonally forward toward the ends of the posterior and middle pairs of lobes. A corresponding median rib curves so as to approach the lateral posterior termination of the axial lobe. The axial lobe of the pygidium is prominent anteriorly, and becomes lower and narrower to a point about six-tenths of the length of the pygidium from the anterior margin, after which the sides of the axial lobe diverge again. All of the ribs beneath the pleural lobes of the pygidium probably locate more or less distinct grooves on the upper, not exposed side of the pygidium. Two segments are indicated at the anterior end of the axial lobe. The anterior one of these is short but

distinct. The second is much shorter, and comparatively indistinct; its posterior margin is on a line with the inner termination of the median rib of the middle pair of lobes. The reflexed margin or doublure extends back for almost half the length of the pygidium along its middle part. The entire exterior surface of the pygidium is covered by small granules, about a sixth of a millimeter in diameter.

Found in the Whitewater division of the Richmond group, at Richmond, Indiana, by John Misener. The species evidently is closely related to *Amphilichas halli*, Foerste, from the Corryville member of the Maysville group, at Cincinnati, Ohio.

The Misener collection contains also a fragment of a pygidium of *Arctinurus harrisi*, Miller, obtained from the immediate vicinity of Richmond, Indiana. In Bassler's Bibliographic Index of American Ordovician and Silurian Fossils, the type is listed as coming from the Liberty member of the Richmond, near Waynesville, Ohio. Figure 1 on plate III is a diagrammatic representation of the pygidium of this species. It is characterized chiefly by the acute termination of the axial lobe. The three pairs of lateral lobes are rounded and subequal.

Tripteroceras (*Lambeoceras*) *richmondensis*, sp. nov.

Plate I, Figs. 3 A, B, C, D; Plate III, Fig. 2

Orthoceracone greatly compressed, transverse section (figure 2, on plate III) lenticular, the lateral edges acute. Radius of curvature across the middle of the septa slightly more than half of the chord connecting the ends of the arc formed by the septa; for instance, the radius of curvature of the lowest septum preserved in the specimen figured is 28 millimeters, and the lateral diameter of the shell at this point is 53 millimeters. Along the ventral side of the shell the transverse curvature of the septa is somewhat greater than on the dorsal side, causing the suture line on this side to rise more rapidly than on the dorsal side until within a distance of 5 to 7 millimeters of the acute lateral angles of the shell,

beyond which there is a slight reversal of curvature. This causes the lateral parts of the septa to slope moderately upward from the dorsal toward the ventral side.

The dorsal and ventral sides of the orthoceracone are about equally convex. The radius of curvature equals about seven-tenths of the chord connecting the ends of the arc formed by the curvature. The lateral sides diverge at an angle of about 7 degrees. The antero-posterior diameter of the shell is 20 millimeters where its width is 53 millimeters. From this point upward 10 chambers occur in a length of 48 millimeters.

The siphuncle, or at least the cast of its interior, is nummuloidal, the lateral diameter being 7 millimeters where the shell is 53 millimeters wide. The more exact structure of the siphuncle has not been determined.

This species occurs in the Whitewater division of the Richmond, at Richmond, Indiana, where the specimens here figured were collected by John Misener. Similar specimens occur in the Emswiler collection in the Museum of Earlham College, at Richmond, Indiana, and are there numbered 8205 A, 8205 B, and 8206 A.

In Bassler's Bibliographic Index of American Ordovician and Silurian Fossils (Bull. 92, U. S. Nat. Mus., 1915), seven species are listed under *Tripteroceras*. In six of these species, including the genotype, *Tripteroceras hastatum*, Billings, the ventral side is strongly flattened and the dorsal side is more or less triangularly convex. However, in *Tripteroceras lambi*, Whiteaves, these two sides are almost equally convex, the transverse section is fusiform, the lateral angles are almost acute, the siphuncle is nummuloidal, and the margins of the septa are deeply concave on both the ventral and dorsal sides. For this species the subgeneric term *Lambeoceras* is here proposed.

Tripteroceras richmondensis is closely related to *Tripteroceras lambi*. The differences are slight. In *Tripteroceras richmondensis* the angle of divergence of the lateral outlines is less, and the septa are more strongly concave and form a more acute angle with the lateral margins.

Tripteroceras lambi was described as from the Trenton or Black River strata at East Selkirk, in Manitoba, but in Bassler's Bibliographic Index the possibility of the East Selkirk horizon belonging to the Richmond is indicated. Clarke identified with this species a closely similar form from the middle Galena at Stewartsville, Minnesota, but here also Bassler questions the reference of the horizon to the Trenton.

Conchopeltis miseneri, sp. nov.

Plate I, Figs. 4 A, B

Shell patelliform, with an upturned beak, the curvature of the shell immediately posterior to the beak being concave, the concave tendency remaining as far as the posterior margin of the shell, but to a lesser degree. Possibly there is also a slightly concave curvature from the beak forward, toward the anterior margin, but this can not be determined definitely from the specimen at hand. From the beak two grooves extend forward, one on each side of the shell, forming angles of about 150 degrees with each other. Anterior to these grooves (marked A, A, in figure 4 on plate I), the shell is comparatively smooth or is marked only by obscure and narrow radiating plications. Posterior to these grooves the shell is strongly and radiately plicated. Of these plications there are eleven. The anterior pair, one plication on each side of the shell, is almost as broad as the third pair, but the crest lies nearer the posterior margin. The second pair (marked B, B, in the figure) is conspicuously narrower. The remaining plications, seven in number, are strongly convex, and are separated by comparatively deep concave grooves. The entire shell is marked by concentric lines of growth. These lines indicate that the general outline of the shell was oval or nearly circular, and not quadrilobate as in *Conchopeltis alternata*, Walcott, from the Trenton limestone of New York, the type species of the genus. In the species here described there may have been a slight indentation of the margin of the shell at the ends of the anterior grooves (marked A, A, in the figure), giving the

appearance of an anterior lobe, but this part of the margin of the shell is not preserved in the specimen at hand.

This specimen is imperfect, and exhibits only the interior of the shell. The figure here presented consists of a cast of this interior. No muscular or vascular markings are discernible. The species occurs in the Whitewater member of the Richmond group, and the type was found by John Misener, at Richmond, Indiana.

Dinorthis retrorsa, Salter

Plate II, Figs. 1 A, B, C; Plate III, Figs. 4, 4a, 4c

Orthis retrorsa, Salter, was described (in the Memoirs of the Geological Survey of Great Britain, vol. 2, pt. 1, 1848, p. 373, pl. XXVII, figs. 3, 4) by Salter as a variety of his *Orthis inflata*. His original description follows:

> Ventral valve gibbous, the center rather raised. Dorsal flat, broadly depressed along the middle, edge not recurved; beak suppressed; area at an obtuse angle with the valve.
>
> *Locality.*—Bird's-hill Quarries, North of Llandilo, in limestone.

In this description the terms ventral and dorsal are used in the same sense as that in which they were employed by Hall in volume 1 of the Paleontology of New York, published in 1847, and familiar to American readers. Later these terms were employed by paleontologists in a directly opposite sense, and more recently the terms pedicel and brachial have come into use, so that a revised version of the original description of *Orthis retrorsa* would read:

> Brachial valve gibbous, the center rather raised. Pedicel valve flat, broadly depressed along the middle, edge not recurved; beak suppressed; area at an obtuse angle with the valve.

Two sets of figures, differing distinctly in outline, accompany the original description, and are reproduced with the original numbering on plate III of this journal. Figure 3 evidently represents the brachial valve of a species of *Hebertella* while figure 4 represents the pedicel valve of a species belonging to the *Plaesiomys* division of *Dinorthis*. The term *retrorsa* refers to the retrorsion of the beak of the pedicel valve, and hence the specimen represented by figure 4 is regarded as the type.

This figure appears to be based upon specimen 11212 in the Museum of Practical Geology, in London, and two additional figures of this specimen, one from a plaster cast (Fig. 1A), the other from a dental wax squeeze (Fig. 1B) are presented on plate II. A second specimen, collected at the type locality about 11 years ago, consists of two small slabs, one the obverse of the other, bearing the numbers J. P. 4031 and 4032, in the Museum of the Geological Survey of Great Britain, Fig. 1C on plate II is based on a plaster cast of a part of the slab numbered 4032. The type locality is described as: the Old Quarry (the first quarry south of the Quarry Cottage) 200 yards northwest of Birdshill farm, Llandeilo, 6″ 33 S. W. E., 1″ 212 Carmarthen, in southern Wales. Horizon: Bala.

It is evident that Salter's description of *Orthis retrorsa* was intended to contrast with that of his *Orthis inflata*, printed on page 372 of the same publication, in which the brachial valve is described as "strongly gibbous, a little emarginate in front," while the pedicel valve is described as "convex at the beak, then flat, or broadly depressed along the middle, the sides recurved; its area broadish, at right angles to the valve."

Orthis inflata was described from the Coniston limestone, in Westmoreland, in northern England; and was stated to occur also in North Wales. One of the specimens in the collections of the Geological Survey of Great Britain numbered 26039, and listed as "*Orthis*, Coniston limestone, Coniston," represents a pedicel valve of this species. The small fragment of the hinge area remaining on each side of the foramen is distinctly at right angles to the valve, and the quadrangular muscular impression follows the description presented by Salter. This specimen is illustrated by figure 1D, on plate II. Evidently *Orthis inflata* belongs to the *Dinorthis subquadrata* group of species, while *Orthis retrorsa* is a retrorse form, closely similar to, if not identical with, *Dinorthis carleyi* among American species.

The Coniston limestone is a member of the Bala group; therefore both *Orthis inflata* and *Orthis retrorsa* belong to the same general group of strata, but one species may have pre-

ceded the other within this group. The Bala group of Wales and England corresponds approximately to the Mohawkian division among American strata, and in these Mohawkian strata of America species occur which unquestionably belong to the retrorse division of *Dinorthis*. Among these is the species collected by Billings (Palaeozoic Fossils, vol. I, 1865, p. 136. figs. 112 a, b) from the Trenton at Ottawa, Belleville, and near l'Original, in Canada, and also the species figured by Ruedemann (New York State Museum Bulletin, 162, 1912, p. 93, pl. 4, figs. 9–12) from the Snake Hill (Trenton) beds, in Saratoga county, New York. Compared with the type of *Orthis retrorsa*, these Trenton specimens are much smaller and apparently have a more nearly circular outline.

Dinorthis carleyi, Hall (Figs. 3 A–E, on plate II of this journal), from the lower or Arnheim member of the Richmond group, in Ohio, Indiana, Kentucky, and Tennessee, also usually is more elongate and more circular in outline than the type of *Orthis retrorsa*, but not enough specimens of the latter are known to indicate its range of variation in form. The assumption that *Dinorthis carleyi* eventually will prove distinct from typical *Dinorthis retrorsa* is based upon the fact that they come from very different horizons. Until the brachial valve of *Dinorthis retrorsa*, from the type locality in Wales, is known, it will be impossible to discriminate the American Richmond forms with any degree of certainty.

Dinorthis carleyi insolens, Foerste (Figs. 2 A, B, on plate II), from the base of the upper or Blanchester division of the Waynesville member of the Richmond group, in Ohio and Indiana, is merely a variety tending to have broader and flatter plications.

The brachial valve (Figs. 3, 3a, 3b, on plate III) erroneously described and figured by Salter as belonging to *Orthis retrorsa* evidently is a *Hebertella*, as already stated. It is numbered 11213 in the Museum of Practical Geology, in London, and figure 1F on plate II of this journal represents a view of a plaster cast of the same specimen, with an attempt to indicate the probable original outline of the valve. Figures 1G and 1H,

on the same plate, represent similar attempts to indicate the outlines of the brachial valves of this species. They were prepared from plaster casts, taken from specimens numbered J. P. 4067 and 4024 respectively in the register of the Geological Survey of Great Britain. These specimens were obtained about 11 years ago at the same locality as that of the specimen figured by Salter, namely Bird's-hill. All three specimens show distinctly the strong convexity and the low, but comparatively broad median elevation demanded by Salter's description and figures. Whether specimen J. P. 4078, represented by figure 1E on plate II, belongs to the same species of *Hebertella* is uncertain. Figures 1F and 1G probably give the more usual outlines of the species. Figure 1H represents an unusually nasute specimen; the postero-lateral angles undoubtedly are too angular. Figures 3e to 3h on plate III indicate the amount of curvature, along the median line, of the brachial valves bearing the same letters in figure 1 on plate II, and figures 3E to 3H on plate III indicate the corresponding lateral curvature across the center of the valves.

These specimens of *Hebertella* from the Bird's-hill locality apparently represent an unnamed species for which the term *Hebertella Llandiloensis* here is proposed. From *Orthis porcata*, M'Coy, it differs in its larger size and in the tendency toward a distinct median elevation. Moreover, the beak of *Orthis porcata* is not retrorse as in *Orthis retrorsa*, the former species belonging to the *Dinorthis subquadrata* group. *Orthis grandis*, Sowerby (Murchison's Silurian System, 1839, p. 638, pl. 20, figs. 12, 13), and *Orthis grandis*, Portlock (Report on the geology of the County of Londonderry and of parts of Tyrone and Fermanagh, Dublin, 1843, p. 452, pl. XXXII, fig. 25), are two much more finely striated species, with a much more quadrangular outline posteriorly, apparently belonging to the *Strophomenacea* rather than to the *Orthacea*.

All of the British specimens here figured were identified by Dr. C. A. Matley, and were loaned by Dr. F. L. Kitchen, the Paleontologist of the Geological Survey of Great Britain, to Dr. F. A. Bather of the British Museum, for the preparation

of the plaster casts. To all of these eminent paleontologists I am greatly indebted for these courtesies. Specimens of *Orthis retrorsa*, from anything near the type locality, are exceedingly difficult to obtain, and the specimens here illustrated represent practically all of the known material available.

Zitteloceras hallianum, D'Orbigny

Plate III, Figs. 5 A, B

1847 Cyrtoceras lamellosum, Hall (not Verneuil, 1842), Pal. New York, 1, p. 93, pl. 41, figs. 2 a–e.

1849. Cyrtoceras hallianus, D'Orbigny, Prodr. Pal., 1, p. 1.

The type of *Cyrtoceras lamellosum*, Hall, numbered 823, is preserved in the American Museum of Natural History, in New York City. It is a fragment 23 mm. long, and of this length about 10 mm. belongs to the body cavity. This is followed by five chambers occupying a length of about 5.5 mm. The width is slightly greater than the length, the width at the base of the body cavity being 11.5 mm., and the antero-posterior diameter 9.5 mm. The rate of tapering toward the apical end is small, the lateral diameter at the smaller end of the fragment being 9 mm. The surface is ornamented by rather distant sharp, undulate, transverse, squamose lamellae. Of these there are eight in a length of 10 mm. Along the median part of the ventral side these well defined transverse lamellae are curved strongly toward the apical end for a distance equal to about the distance between the lamellae. Originally these lamellae may have extended for a distance of about half a millimeter from the general surface of the cyrtoceracone; they evidently represent stages of growth. Laterally, these lamellae undulate in a series of scallops, as indicated on the upper left-hand part of the accompanying illustration, figure 1A.

The type was obtained in the Trenton limestone at Middleville, New York.

It is evident that *Cyrtoceras hitzi*, Foerste (Denison Univ. Bull. XVI, 1910, p. 78, pl. I, figs. 7 A, B; pl. II, figs. 23 A, B, C), from the uppermost Richmond strata exposed at Mad-

ison, Indiana, is a closely related species, and therefore should be referred to *Zitteloceras*.

Zitteloceras clarkeanum, sp. nov.

1897. Cyrtoceras hallianus, Clarke, Geol. Minnesota, 3, pt. 2, p. 805, pl. 60, figs. 11, 12.

The specimen figured by Clarke from the Platteville member of the Black River group, at Janesville, Wisconsin, differs from the type of *Zitteloceras hallianum* in its ovate cross-section, more rapid attenuation toward the apical end, and larger size. The regularly spaced squamose growth-lamellae of *Zitteloceras hallianum* are replaced by numerous lunate markings with the convex side turned toward the larger end of the specimen, apparently similar to the ornamentation presented by *Cyrtoceras* (*Glyptodendron*) *eatonense*, Claypole, as figured in the Geology of Ohio, volume VII, on page 536, in 1893.

The specimen figured by Clarke is regarded as sufficiently distinct to receive a separate designation, and hence the name *Zitteloceras clarkeanus* is proposed, in honor of the distinguished paleontologist, John M. Clarke, who first described it.

PLATE I

Fig. 1. Conularia miseneri. A, natural size of cast of specimen; B, outline of cross-section of same; C, same specimen, enlarged 5 diameters, and illuminated so as to show the vertical striations. Whitewater member of Richmond group, at Richmond, Indiana.

Fig. 2. Amphilichas sp. Lower side of pygidium and of parts of several segments; the two anterior lobes and the middle lobe on the right side of the pygidium are missing. Whitewater member of Richmond group, at Richmond, Indiana.

Fig. 3. Tripteroceras richmondensis. A, ventral side; B, lateral view of inverted specimen, showing location of siphuncle, toward the lateral angle the septum slopes from the dorsal toward the ventral side in a direction away from the apical end of the specimen; C, weathered specimen, with indications of the nummuloidal fillings of the interior of the siphuncle. D, a similar weathered specimen apparently showing the exterior of the siphuncle. The exact structure of the siphuncle has not been determined. Whitewater member of the Richmond group, at Richmond, Indiana.

Fig. 4. Conchopeltis miseneri. A, cast of specimen with approximate outline indicated, exact outline unknown. A, A, anterior pair of grooves limiting anterior "lobe" in which strong radiating ribs are absent. B, B, C, C, second and third pair of ribs or plications. F, posterior, unpaired plication. B, outline, on lateral view. Whitewater member of Richmond group, at Richmond, Indiana.

All of the specimens on this plate were collected by John Misener.

PLATE II

Fig. 1, A, B, C. Dinorthis retrorsa, Salter. Pedicel valves; A, B, two views of the type, from Bird's-hill, north of Llandilo, in southern Wales. C, another valve from the same locality.

Fig. 1, D. Dinorthis inflata, Salter. Interior of pedicel valve from the type locality: in the Coniston limestone, at Coniston, in northern England.

Fig. 1, F, G, H. Hebertella Llandiloensis, sp. nov. Brachial valves. F, figured incorrectly by Salter as one of the valves of Dinorthis retrorsa; G, H, other valves from the same locality: Bird's-hill, north of Llandilo, in southern Wales. E, another brachial valve from

the same locality, possibly belonging to the same species. All of the figures on this plate which are numbered under 1 are from plaster casts prepared by Dr. F. A. Bather of the British Museum, from the original specimens.

Fig. 2. Dinorthis carleyi insolens, Foerste. A, B, pedicel valves. From base of Blanchester division of Waynesville member of Richmond group, near Miltonville, Ohio.

Fig. 3. Dinorthis carleyi, Hall. A, B, pedicel valves; C, brachial valve; D, E, interiors of pedicel valves. Arnheim member of Richmond group, at Oregonia, Ohio.

PLATE III

Fig. 1. Arctinurus harrisi, Miller. Pygidium of type, Liberty member of Richmond group, Waynesville, Ohio.

Fig. 2. Tripteroceras richmondensis, sp. nov. Transverse section of specimen represented by figure 3 on Plate I.

Fig. 3. Hebertella Llandiloensis, sp. nov. 3, brachial valve erroneously figured by Salter as belonging to Dinorthis retrorsa; a, posterior view of the same; b, posterior view of same combined with that of Dinorthis retrorsa; e–h, outlines indicating curvature from beak to anterior margin of specimens bearing the same letter in figure 1 on plate II; E–H, corresponding transverse sections across the center of these valves. Bird's-hill, north of Llandilo, in southern Wales.

Fig. 4. Dinorthis retrorsa, Salter. Pedicel valves; 4, 4a, exterior and cast of interior. The original of the latter appears to have been lost. c, outline indicating slope of hinge area and curvature of valve along the middle line, from the beak to the anterior margin.

Bird's-hill, north of Llandilo, in southern Wales. Figures, 3 3a, 3b, 4, 4a are reproductions of the original figures accompanying the description of Orthis retrorsa, by Salter, in the Memoirs of the Geological Survey of Great Britain, vol. 2, pt. 1, on plate XXVII, and retain the original numbering.

Fig. 5. Zitteloceras hallianum, D'Orbigny. A, lateral view; B, ventral view, enlarged 2.6 diameters. Type, numbered 823, in the American Museum of Natural History, in New York City. From the Trenton limestone, at Middleville, New York.

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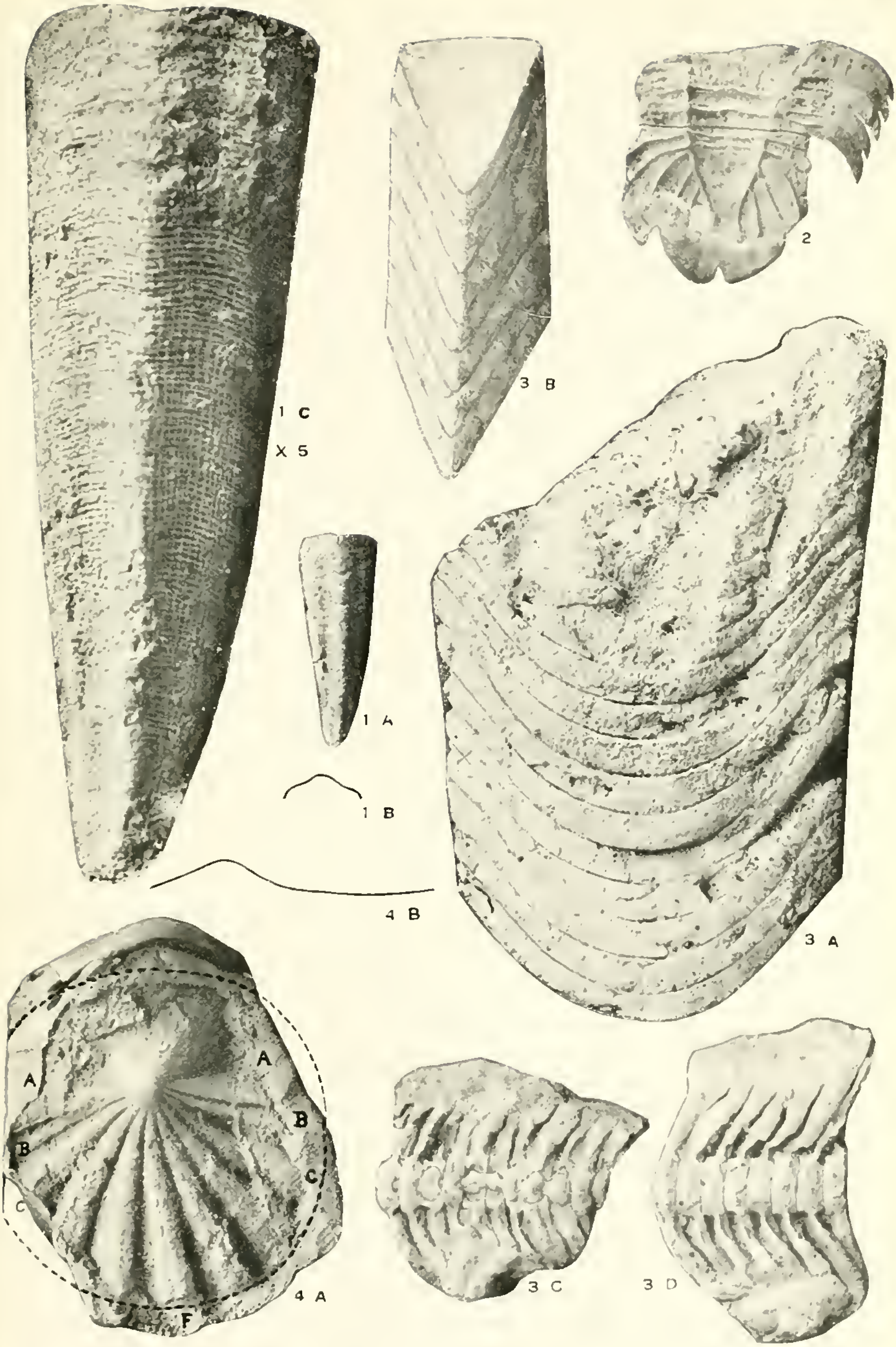

Plate I

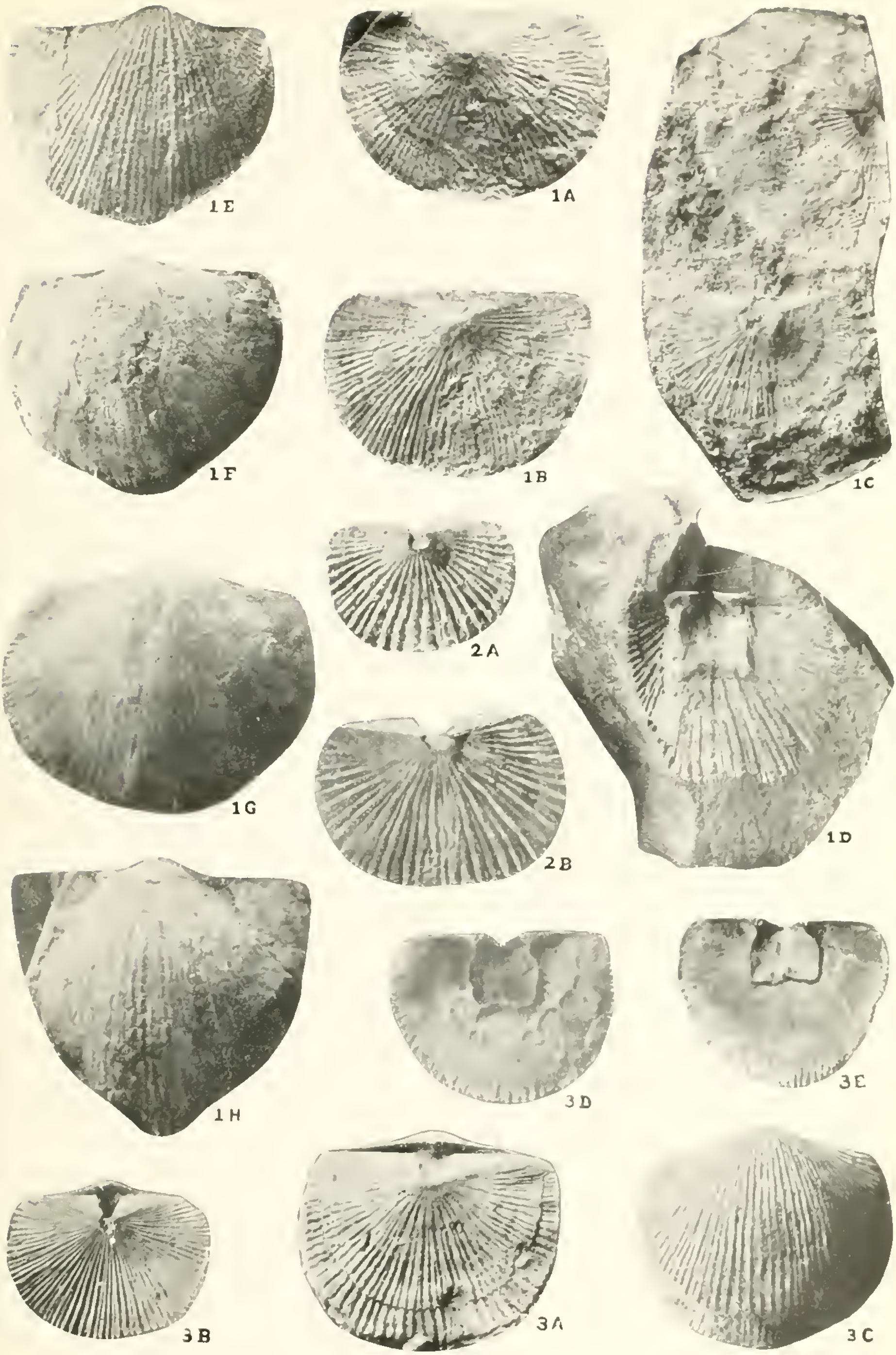

Plate II

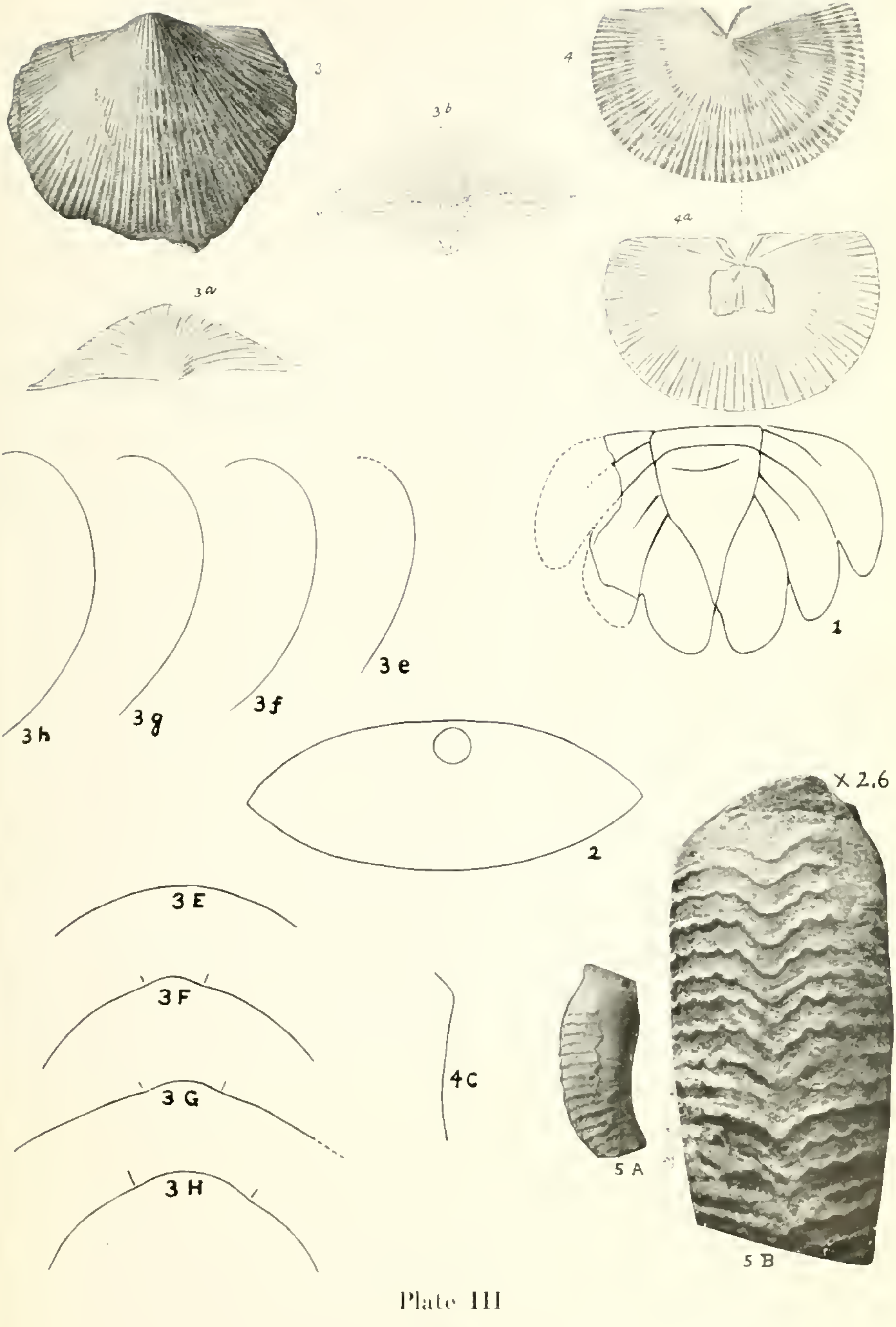

Plate III